Of this issue more than 4000 copies were printed

The Welding Engineer

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The Welding Engineer
L. B. Mackenzie, Editor
Member of Audit Bureau of Circulations

*Alphabetical Index to Advertisers and Buyers' Index, Page 4.

The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

Oxweld Supplies are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

Write us for information on any class of Welding or Cutting Work

Oxweld Acetylene Company

CHICAGO
36th St. and Jasper Place

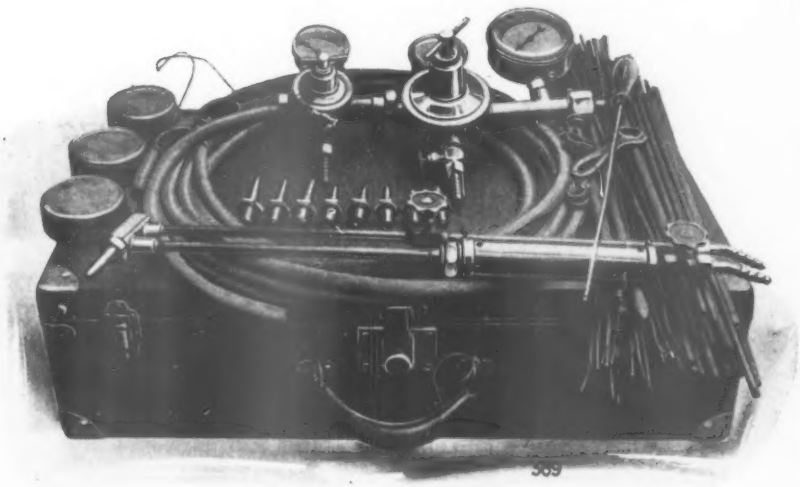
NEWARK, N. J.
6460-680 Frelinghuysen Ave.

LOS ANGELES
654-656 Pacific Electric Bldg.

The BUCKEYE Oxy-Acetylene Welding and Cutting Outfits

Stationary and Portable

We Build · Preheating Kerosene Torches and Oil Furnaces



Live Men Wanted to Represent Us on Commission in Territory Not Allotted Only Men Who Will Demonstrate Desired

We Build Both Oxygen as Well as Acetylene Generators

Ask for Catalog K

THE MACLEOD CO., Bogen Street, CINCINNATI, OHIO

Every Welder!

The Imperial Hand Book of Welding, Cutting and Decarbonizing is what every welder has been looking for.

It contains 60 pages, 40 illustrations—compact—brief—written so every one can understand.

No tedious history of the process, no long involved technical explanation of the chemical and physical action of the gases—just plain, simple directions—all the things every welder must know and understand to make a success.

Imperial Welding and Cutting Equipment has proved to be the safest, most efficient and most economical, and now we offer the **best** welding instructions ever issued—free to users of Imperial Apparatus—$1.00 each to those less fortunate.

The edition is limited—act **now** to be sure of your copy —also ask for catalog and prices of Imperial Equipment.

Imperial Brass Mfg. Co.

522 South Racine Avenue **CHICAGO**

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

ACETYLENE GENERATORS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
International Oxygen Co.
The Macleod Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

ALUMINUM FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM SOLDER

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
The Macleod Co.
Universal Oxygen Co.

APRONS (Asbestos)
Welding Materials.

ASBESTOS GLOVES
Welding Materials.

ASBESTOS SHEET PAPER
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BLOW TORCHES (Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Indiana Oxygen Co.
The Prest-O-Lite Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

BRASS SPELTER WIRE
Universal Oxygen Co.

BRAZING OUTFITS
Buffalo Dental Mfg. Co.
Superior Oxy-Acetylene Machine Co.
The Macleod Co.

BRONZE FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BUTT WELDERS (Electric Resistance)
Thomson Electric Welding Co.
Welding Materials.

CARBIDE (Calcium)
American Carbolite Sales Co.
Union Carbide Sales Co.
Canada Carbide Sales Co.

CARBON REMOVING TORCHES
American Oxygen Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Equipment Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
The Macleod Co.
Metals Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

CAST IRON FILLER RODS AND FLUX
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.
Welding Materials.
General Electric Co.

ELECTROLYTIC OXYGEN PLANTS
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
United States Welding Co.
The Prest-O-Lite Co.

FILLER RODS (Swedish Iron)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Tobin Bronze)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Vanadium Steel)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FLUE WELDERS (Electric Resistance)
Thomson Electric Welding Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
The Macleod Co.
Universal Oxygen Co.

GASOLINE PREHEATING FURNACES
Buffalo Dental Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
The Macleod Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

GLOVES (Asbestos)
United States Welding Co.
Welding Materials.

GOGGLES AND HOODS (Welders)
American Oxygen Co.
William C. Adams.
Bermo Welding Apparatus Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
F. A. Hardy & Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.
Welding Materials.

GLOVES (Welders Asbestos)
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Universal Oxygen Co.

GAUGES (Pressure)
American Oxygen Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
United States Welding Co.
Universal Oxygen Co.
U. S. Gauge Co.

HARDENING FURNACES
Buffalo Dental Mfg. Co.
The Macleod Co.

WELDING OUTFITS
CUTTING OUTFITS

OXY-ACETYLENE WELDING
DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO. N.Y.

Leads the world for range, efficiency and number of outfits in successful use

Davis apparatus offers the widest range of equipment made for employing to its greatest value the oxy-acetylene process of welding and cutting, backed by the longest service, the most extensive experience, and the greatest development in apparatus and in application.

It is employed by the most prominent concerns in the iron and steel and metal working industries, and was awarded the highest honors at the Panama-Pacific International Exposition —two Medals of Honor (higher award than the Gold Medal) and a Gold Medal.

Complete plants with acetylene and oxygen generating and compressing systems, and welding and cutting stations, for the largest industries, with profitable outfits for field work and small plants for general repair shops. Complete information on request.

Davis-Bournonville Company

NEW YORK CHICAGO

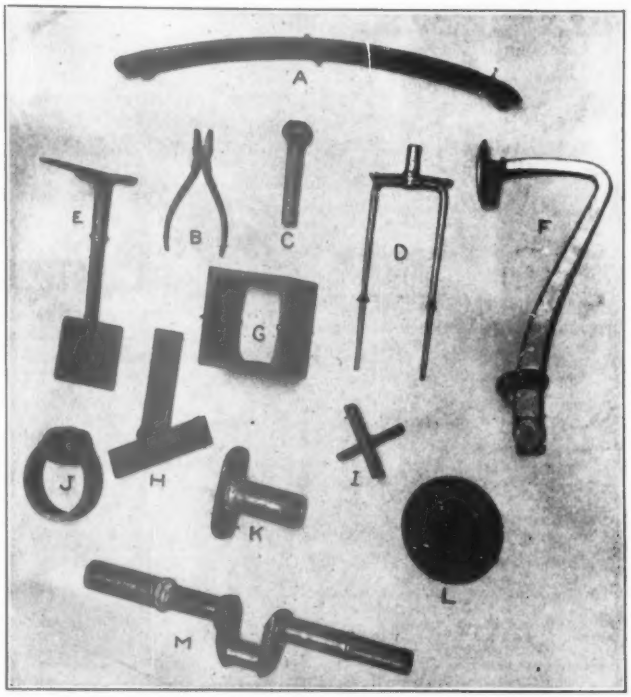
General Offices and Factory: Jersey City, N. Y.

Sales Offices: New York, Chicago, Detroit, Cleveland, Pittsburgh, Philadelphia, Boston.

Have You Investigated

THOMSON

Electric Welders?



A—Spring for Auto.
B—Pliers.
C—Upset rod.
D—New ends welded on worn flyers (cotton mill mach.).
E—Auto step forging.
F—Auto foot brake.
G—Steel frame.
H—Oblique weld-steel flats.
I—Mash welded cross rods.
J—Magnet part.
K—Pipe welded to flange.
L—Solid round welded to forged flange.
M—End welded on single throw crank shaft.

You would be surprised if you knew of the welds which are being made every day on Thomson Electric Welders. There is hardly a metal working establishment in which Thomson Electric Welders can not be employed to very good advantage. Other manufacturers are cutting down costs by the use of welding machinery, at the same time improving the output.

Why not prepare to reduce your manufacturing costs by studying the possibilities right now. Describe the shape, give size of smallest and largest piece, the maximum number of welds required per day, the cost of current per kw. hour, and we will tell you what it will cost you to electric weld.

Thomson Electric Welding Co.

Lynn, Mass., U. S. A.

HOSE (Oxygen and Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co.
United States Welding Co.
Universal Oxygen Co.

HOSE UNIONS
Bermo Welding Apparatus Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

HYDROGEN
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Goldschmidt Thermit Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

OIL BURNERS (Preheating)
The Macleod Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co.

OXYGEN (Compressed in Cylinders)
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

PIPE WELDING
Goldschmitt Thermit Co.

PHOTOGRAPHS
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

PLASTIC (Fireproof)
Welding materials.

PRESSURE GAUGES
The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
United States Welding Co.
Universal Oxygen Co.

RAILROADS—Special Service for
Oxweld Railroad Service Co.

REGULATING VALVES (Acetylene)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Hydrogen)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

REGULATING VALVES (Oxygen)
American Welding Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

SEAM WELDERS (Electric)
General Electric Co.
Westinghouse Electric & Mfg. Co.

SEAM WELDERS (Electric Resistance)
Thomson Electric Welding Co.

SPOT WELDERS (Electric Resistance)
Thomson Electric Welding Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)
Superior Oxy-Acetylene Machine Co.

THERMALENE-GAS
The Thermalene Co.

THERMIT WELDING
Goldschmidt-Thermit Co.

TORCHES (Gasoline and Kerosene Preheating)
Buffalo Dental Mfg. Co.
General Welding & Eq. Co.
The Macleod Co.
The Bishop-Babcock-Becker Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Acetylene Welding)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Welding)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Special to Order)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Superior Oxy-Acetylene Machine Co.

TRUCKS (Cylinder Carriers)
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

VALVES (For Oxygen Cylinders)
The Bastin-Blessing Co.
International Oxygen Co.
Universal Oxygen Co.

WELDING (Electric Resistance-Custom Work)
Thomson Electric Welding Co.

WELDERS' GOGGLES
William C. Adams.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

WELDING (Oxygen for)
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Acetylene)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Hydrogen)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Imperial Brass Mfg. Co.
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Universal Oxygen Co.

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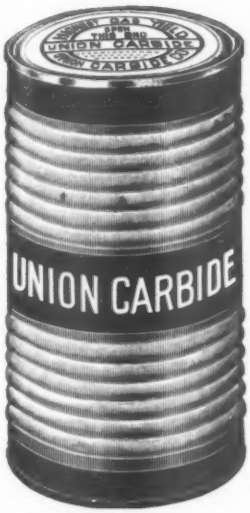

Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 42nd St. Building | **Chicago, Ill., Peoples Gas Building** | **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

$3\frac{1}{2}$ x 2 in. —a large size.

$1\frac{1}{4}$ x $\frac{3}{8}$ in. —an intermediate size.

2 x $\frac{1}{2}$ in. —a medium size.

$\frac{1}{4}$ x 1/12 in. —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

ALABAMA
Birmingham—1916 Morris Ave.
Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.
ARIZONA
Phoenix—16 S. Central Ave.
ARKANSAS
Fort Smith—109-123 So. Ninth St.
CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—877 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—418 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—721-731 So. Washington St.
Marion—315 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.
INDIANA
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—921 Wabash Ave.
IOWA
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—925 Fourth St., P. O. Box 398.
KANSAS
Pittsburg—109 W. Third St.
Salina—103 S. Fifth St.
Wichita—721 Beacon Building.
KENTUCKY
Louisville—126 E. Main St.
LOUISIANA
New Orleans—715-717 Perdido St.
MAINE
Portland—202 Commercial St.
MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.
MICHIGAN
Detroit—Jefferson Ave. and Orleans St.
Grand Rapids—135 Ottawa Ave., N. Y.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
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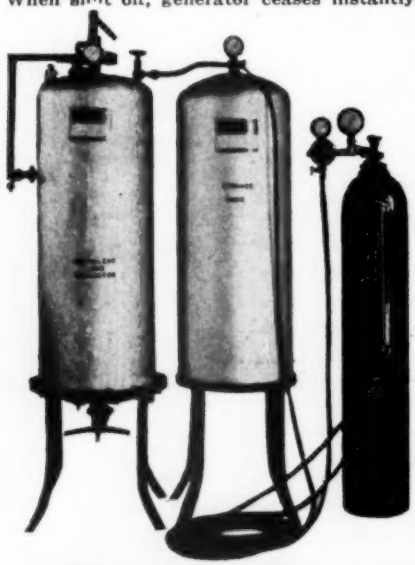

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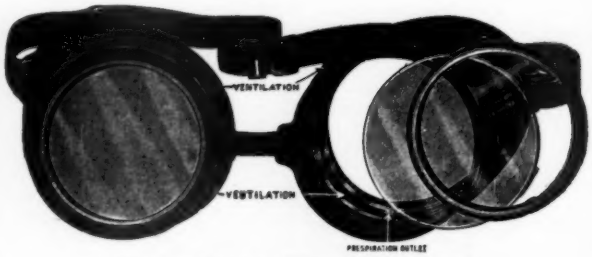

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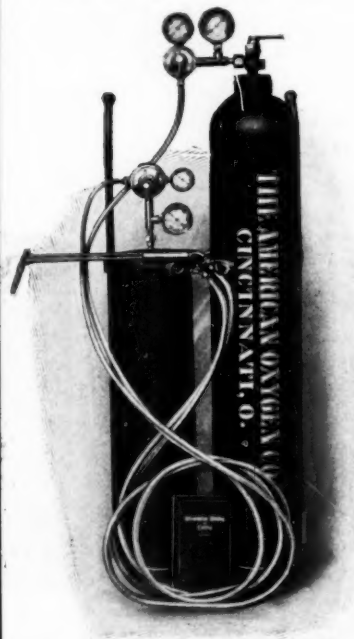

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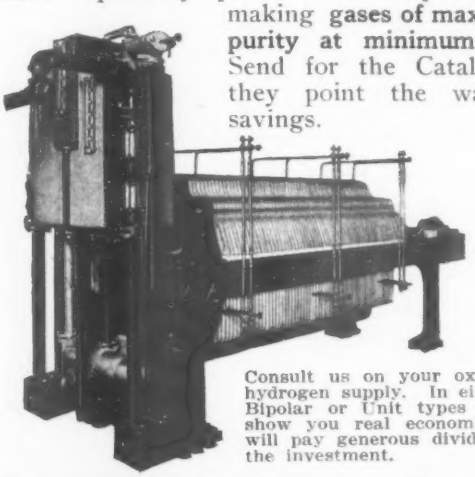
More Cutting and Welding Per Cubic Foot of Gas

Of course, impure oxygen and hydrogen will do your work—after a fashion. But it is to your interest to know that high-purity I.O.C. oxygen and hydrogen will do **more work** per unit of gas. And they will cost you less, too — for I.O.C. Oxyhydrogen Generators have repeatedly proved their capacity for making **gases of maximum purity at minimum cost.** Send for the Catalogs — they point the way to savings.



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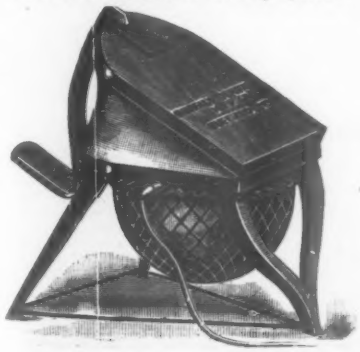
Bermo Welding Apparatus Co.

Omaha, Nebraska, U. S. A.

No. 10 Foot Blower, $6.00



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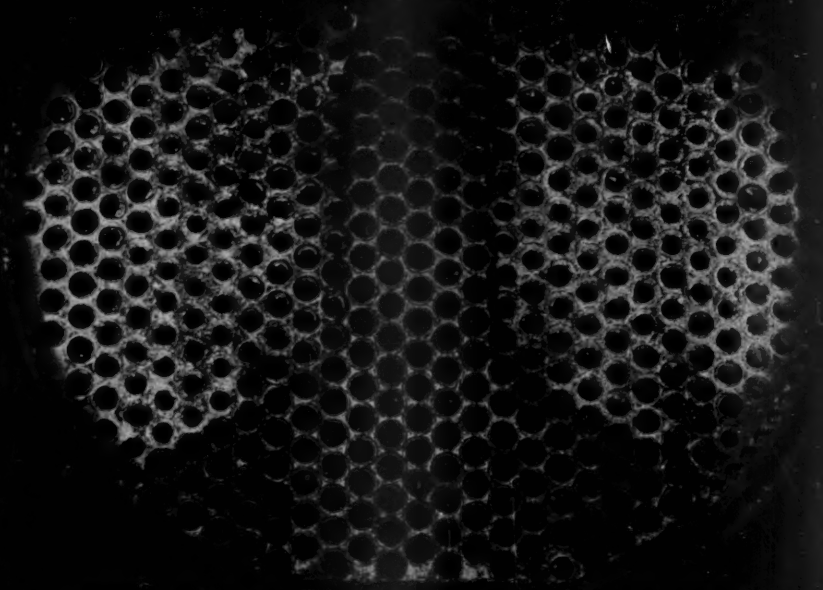
Carbon electrode used for cutting or heavy current welding



Metal electrode builds up or fills cavities when welding

Light portions show welded tube ends in locomotive

BENEATH the C & O locomotive illustrated above, which has welded seams and flue sheets, is shown a partly completed locomotive flue sheet. The light portions show flue ends which have been welded by a G-E arc welding outfit, one type of which, used by the American Locomotive Company, is shown at the bottom of this page.

This welder does its own chipping, so work can go on when your chippers are busy elsewhere. The control of heat and building of metal possible with this welder prevents distortion, uneven crystallization and cavities.

A G-E arc welder will repair worn or broken parts while they are in place. Our nearest office will be pleased to give you additional information.

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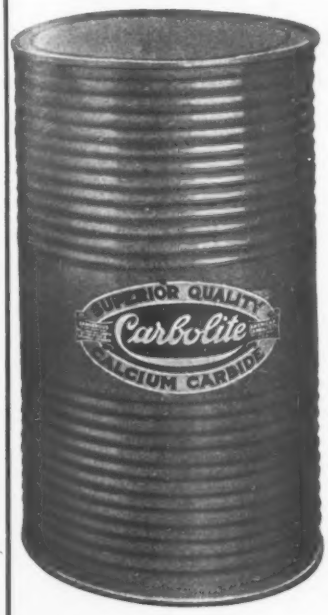

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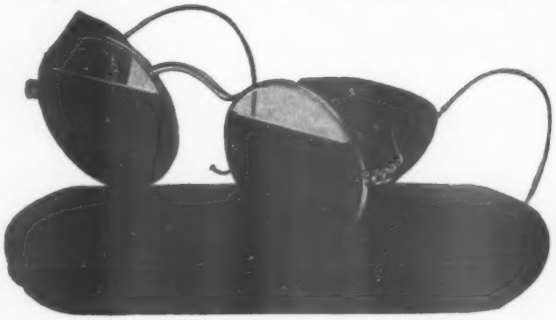
Please address request for information or prices to General Office, Duluth, Minn.

Albex Bifocals



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Solid white metal frames, easy cable temples, leather sides and adjustable bridges.

Upper part, clear glass; lower part, gray green Hallauer glass for welding.

Per pair - - - - - - - - - - - - $1.50

Blue-White

Same frame with the upper part, cobalt blue glass; lower part, clear glass.

Each pair supplied with a strong steel case.

Per pair - - - - - - - - - - - - $1.50

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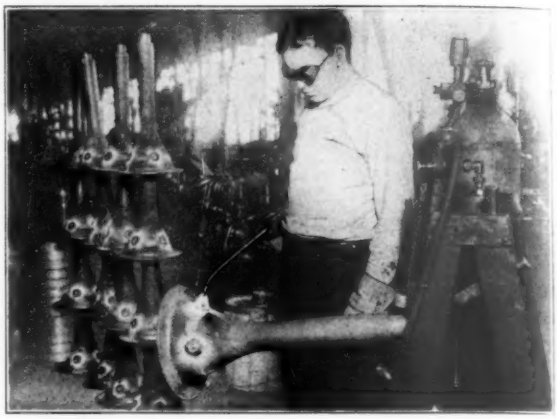

Prest-O-Lite Process used in the manufacture of the Marmon 34 rear axle. "Tacking" rivets used to hold bearing support (inside) in alignment, preparatory to welding.

Aside from any other process of metal joining you may now be using in your shop, you need the Prest-O-Lite Oxy-Acetylene Process. In thousands of shops and factories, it is everywhere in predominant use for a large variety of manufacturing and repair operations.

It will greatly enlarge your range of operations because with this welding process you can handle easily and economically many difficult operations that are practically impossible by other methods.

Investigate the great opportunities for increased quality and decreased cost made possible on **all kinds** of metal joining operations by the

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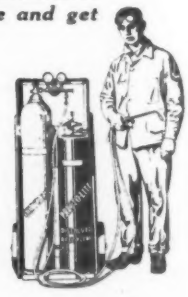
Employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite Dissolved Acetylene (ready-made carbide gas) is backed by Prest-O-Lite Service, which provides dry purified gas, insuring better welds, quicker work, and lower cost, and also avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

The necessary equipment is not expensive. We furnish high-grade welding apparatus for $60 (Canada, $75); acetylene service at additional cost. Also adaptable for oxy-acetylene cutting by the purchase of a special cutting blow-pipe. Thorough instructions are furnished free to every user—any average workman who understands metals can learn the process quickly.

Let us send you extensive data and valuable illustrated literature free. The advice and assistance of our Welding engineers are at the disposal of Prest-O-Lite users at all times. Write and get their advice in any metal joining problem now confronting you.



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The Welding Engineer

Published on the First Thursday of Each Month by

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L. B. Mackenzie.....President and Editor

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We guarantee that of this issue more than 4,000 copies were printed, excluding copies spoiled in press room and bindery. At the time of mailing the known distribution was (actual count always exceeds press order):

Copies to paid subscribers	1,823
Copies to advertisers	56
Copies to prospective advertisers	0
Copies to other trade papers, correspondents, etc.	10
Copies mailed as samples to prospective subscribers	1,801
Copies retained at office of publication to fill new subscription orders, etc.	300
Copies for office use	10
TOTAL	4,000

VOLUME 1. SEPTEMBER, 1916. NUMBER 9.

The Demand For Welders

IN a recent issue of a Detroit newspaper we noticed practically a column of classified advertisements for welders. Of course, Detroit is experiencing a remarkable period of prosperity, but this is no doubt true of most any big city you might name. As a matter of fact we do not believe the demand for experienced welders will fall off after the war. On the contrary we think there will be an increasing demand for capable men. As we have said before, a welding process of some kind is an economic or a measure, and the progress of the industry can hardly be arrested.

Teaching Welding.

A CORRESPONDENT who is deeply interested in welding schools writes to ask us if we can suggest some marketable article students of welding might manufacture while attending school. The idea is, of course, to put the student and the school on a more solid financial basis. In discussing this question with a gentleman, who may be said to be one of our pioneer welding engineers, we are favored with the following criticism of the plan:

"In my opinion it would be highly injudicious for welding schools to attempt to allow their students to produce articles for sale. As soon as a welding student becomes efficient on any particular line of work it is time for him to stop practicing on that class of work in the school and to get something he is not efficient at. If he were allowed to produce articles for sale, before he was really efficient in the welding-up of these articles he would undoubtedly produce inferior articles. This would be circulated and there would be complaints concerning the articles, with the result that more harm than good would be done to the welding industry. I believe if welding schools were trying to produce articles for sale they would in time, and only naturally, begin to develop into manufacturing concerns and students would be kept on the one class of work which they produced most efficiently, instead of being swung over continually to different classes of work."

Bunk Welding Schools.

WE know of a certain so-called school of welding which charges students fifty dollars for a complete course. This school advertises steadily and claims to secure positions for graduates, wages as high as ten dollars per day being promised. The students turned out by this particular school can by no stress of imagination be called welders. In fact they have hardly enough training to qualify as helpers. This is injurious to the entire welding industry and we are inclined to think that the proprietors of such schools, who deliberately publish false and misleading advertisements, should be prosecuted.

A Railroad Saves Money.

THE FOREMAN of the welding department of a big western railroad recently found he could make a satisfactory substitute for brass locomotive oil cups out of sheet iron, the saving amounting to more than four dollars per cup. A thousand oil cups were made up out of sheet iron and are in stock to be used as required. This serves to illustrate the adaptability of the welding process and emphasizes the value of a master welder who can see beyond the end of his nose. This particular foreman, if he were given a roving commission, could save the price of a small railroad in a few years, simply by virtue of his appreciation of the flexibility of the art of welding.

Drop Forging Defects

THE application of welding processes to the correction of flaws in drop forgings is one of the recent developments in the welding field. The defects in drop forgings are due to three primary causes. First, insufficient metal to fill out dies; second, imperfect flow of metal; third, foreign matter lodging in dies, causing dents or holes. Since the value of a drop forged automobile axle may be from $35 to $40 the loss of an axle is a serious matter. Undoubtedly the great pressure which is being brought to bear on automobile manufacturers, in the form of competition and lowering selling prices, will result in more attention being given the subject of welding.

The Business Outlook.

WHAT the future holds for American industries is a matter of keen interest. When orders begin to fall off in the big plants the smaller institutions are not long in feeling the depression. The steel industry is of particular interest to the welding trade, for it is the very foundation upon which our prosperity rests. In a recent editorial *The Iron Age* says of the outlook in the steel market:

"Reviews of the steel market have pointed out in the past six weeks that the whole attitude of consumers toward the market has changed. The continuance of heavy purchases from abroad, with deliveries running six months and nine months ahead, and the appearance of large export inquiry for steel for other than war purposes seems to have removed all question as to the full operation of the steel capacity of the country for many months to come, and has centered attention on the buying of steel at present contract prices for delivery running well into 1917.

Nothing has so impressed students of the present remarkable situation in the steel trade with the strength of the producers' position as the measures the mills have adopted to secure a proper distribution of their output. In previous booms buyers ordered heavily ahead and then reckoned that at some time, though it might be distant, the mills would reach these orders and from then on the buyers' course would be smooth. The difference now is striking.

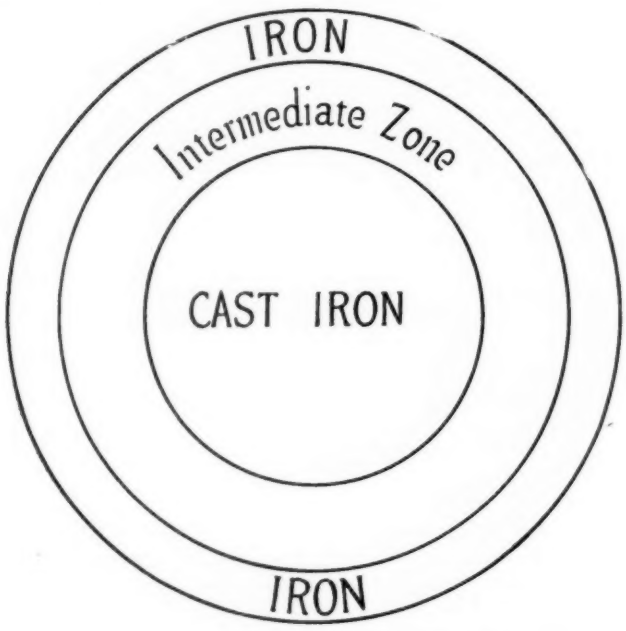
Welding and Brazing of Malleable Cast Iron

Results of Practical Experience in Handling This Very Difficult Metal

By B. Kopferschmidt

Malleable cast iron is a crude form of wrought iron obtained by decarbonization. The castings are made in the ordinary way from low silicon iron with little phosphorus and sulphur; they are placed in cast iron boxes in contact with oxide of iron or peroxide of mangenese and heated to a red heat, until most of the carbon is removed from the surface; thus the reaction commences at the surface of the casting and spreads more or less to the interior of the metal. In this case the articles of malleable cast iron consist of a core of cast iron surrounded by a layer of iron. Therefore it is understood that between the surface, which is almost free from carbon, and the center of the core, which is cast iron, there exists a carbonized intermediate zone (Fig. 1) according to its distance from the surface or the core.

In most cases, thin articles are sometimes totally decar-



No. 1.—Cross Section of Malleable Cast Bar.

bonized, and if the thickness does not exceed ¼ inch, they can be welded just the same as in the case of mild steel, using a pure Norway iron welding rod of the first quality.

On the contrary, in the thick parts, the core of cast iron is present, and the welding operation becomes questionable on account of the entirely different nature of the metal between the surface and the core and their different melting points. Therefore as a general rule, all thick parts of malleable castings cannot be welded properly.

However, there is a way, with the aid of the oxy-acetylene blowpipe, to repair almost any malleable cast iron article with the brazing process.

Method of Brazing.

There are two methods of brazing malleable cast iron, the beveled and close process.

The beveled method required beveling the crack or fracture to a 45 degree angle and cleaning the neighboring sides of the bevel about ½ inch. Then heat the bevel uniformly on both sides to a bright red. Apply with a small stone a little cleaning flux on both sides of the bevel and on the surface. When the flux is thus applied, the flame should not be removed and right after this a ¼ inch Tobin bronze welding rod should be heated at the extreme end and dipped in the flux, and, presuming that the casting is a bright red, apply the rod in the bevel. When the welding rod is melted one will observe that wherever the flux was applied a brass coating is obtained. It remains then for the operator to fill up bevel with the Tobin bronze rod, overcharging a little more metal on top, all over the brass coated surface. Care should be taken not to attack the metal with the jet, the same as for welding cast iron.

The flux used for this method is the same as used for brass or bronze welding.

The close method of brazing malleable castings is more economical and reliable, but requires more skill. The crack or fracture is not beveled, but just cleaned on both surfaces about ½ inch on each side of crack. It is then preheated with an oil, gas or acetylene blowpipe to a bright red. The skill required on this operation is to secure a uniform heating. To accomplish this, it is necessary to preheat very slowly at the beginning so the heat will penetrate throughout the casting and when the heated portion becomes red it should be red all the way through. Then apply the flux the same as in the first method. If the casting is a bright red on both sides of crack, the flux will penetrate throughout the casting to the bottom surface; then without removing the flame, apply the ¼ inch Tobin bronze welding rod on the surface and, rubbing it on the surface, one will notice that the melted brass will follow the flux throughout the casting and on both surfaces, thus joining both sides of the crack by cooling.

It is understood that the same preheating methods are observed in malleable castings as applied in cast iron to take care of expansion and contraction.

This second method of joining is the most reliable, and the writer experienced on most severe tests that the weld could not break again at the brazing line.

The fluxes used for the second method are "Peerless Flux" or "Superior Brazing Compound."

WELDING AUTO SPRINGS BY THE OXY-ACETYLENE PROCESS.

By O. B. Besner.

Before undertaking to weld automobile springs it is necessary to have the proper equipment, besides some "know how."

First, it is absolutely necessary to have a good torch, one that has the proper mixing principle, so that you can get a neutral fire. There are a number of cheap torches on the market with which it is impossible to get a neutral fire. Adjust your gases so your fire looks right, but when you try to weld high carbon steel with them, you find you cannot do it without burning more or less of the steel. So by all means have a good torch; it is far cheaper in the long run.

Second, you must have a forge, an anvil, hammer and tongs, and some knowledge of blacksmithing.

Third, you must have the leaf that goes next to the broken one, or if more than one, then you want the whole spring.

so that you can fit the leaf after welding, and also give it the proper set, as shown in sketch. No matter how good a weld you make, if it is not properly fitted and set, your job is no good, for each and every spring leaf depends on the next one to it for some support, and any leaf that is not doing its share weakens the whole spring.

Take the broken leaf and V it from both sides, if broken through the bolt hole, V the hole out also; do not try to save it. V out enough of the break so that the leaf will be from 1/8 inch to 1/8 inch shorter, this to allow for drawing out afterwards.

Set the broken leaf as near in position as possible. Before beginning to weld I bring both ends of the steel at the break to a good red heat, then I bring the torch near enough so that the tip of the cone of the inner flame just touches the work. As soon as the metal begins to flow, I pull back just enough to keep the metal melting and not burn it.

Every few seconds, pull the fire off just the fractional part of a second to let the metal set that you have added.

When the weld is completed it should be larger than the rest of the leaf.

I weld springs with spring steel wire 1/8 inch to 1/8 inch in diameter, the kind commonly known as furniture wire. I use a flux composed of equal parts borax, bicarbonate of soda, carbonate of soda (soda ash) and 1/2 part animal charcoal. Keep enough of the flux on the work while welding so that you are practically flowing your metal under a film of it all the time.

After making your weld, let it cool just long enough to set; that is, when it has about lost its red color. Then take it on the emery wheel and grind off the scale and flux, until the metal shows clean; but do not grind it down to size. Now take it in the forge (having previously made sure of a good clean fire) and give it a low borax welding heat, or what is known among blacksmiths as a wash heat, which is just a little hotter than cherry red. Then take it on the anvil and hammer it fast, but not too hard, with a medium sized hammer (2 to 2½ lb.).

Care should be taken to hammer it evenly all over, for if not evenly hammered it will tend edgeways, and is then hard to straighten. Do not hammer it after it is off the red color. Just fit it somewhere near to what it ought to be and then let it cool.

The idea of the hammering is to pack the grain of the steel and toughen it, because all autogenous welds on steel are nothing more or less than cast steel.

After it is cold finish it up to size, and if the break was through the hole, drill it out, then take the leaf and finish fitting and setting in good shape. By warming it to a smoking black heat wherever it wants bending you can soon very easily spring it with a hammer wherever you want to. After you have it fitted, warm it all over to a low even red heat and plunge it in water not colder than 70 degrees Fahrenheit. This hardens it. Now to draw the temper, warm it all over until it is hot enough to make a white pine stick smoke by bringing it in contact with any part of the leaf. Care should be taken not to get it hot enough to ignite the stick, as that would be too hot and leave the spring leaf too soft. After bringing it to the right heat lay it down and let it cool slowly.

Now I do not claim that this method is infallible, but it is the best that I have tried during my 8 years of practical experience. There are certain grades of steel used in making some springs, that no matter how well you weld them nor how carefully you heat treat them afterwards, they will break just to one side of the weld, or right in the edge of it. The above method takes in the general run of American and English steels; but not the specials, which are heat treated, tempered, etc., by secret processes.

NEW USE FOR TORCH.

Mr. S. P. Gentry, Atlanta, Ga., who is connected with the Linde Air Products Co., reports a novel use for the oxy-acetylene cutting torch. The Uncle Sam Target Co., Memphis, Tenn., and they use a torch to cut the figure shown in illustration out of 3/16 steel plate. It is stated that an operator can complete seven of these figures per day. The unusual feature is the symmetrical lines observed, without the aid of an oxygraph machine. This is an amusement device and "Uncle Sam" doffs his hat every time the bulls eye is hit. Where the arm is connected to the figure there are several welds. These people use Prest-o-Lite apparatus and gas and Linde oxygen.

Making Metal Targets with Oxy-Acetylene Torch.

IMPERIAL BRASS ENLARGING.

The Imperial Brass Manufacturing Co., Chicago, announce that construction will be begun immediately on an addition to the present plant. The present building contains 75,000 feet of floor space and the new building will contain an equal area, giving a total of 150,000 square feet. The new building, like the old, will be of heavy mill construction and located on the site adjoining the present plant, which is on the corner of Harrison Street and Racine Avenue, 6 minutes from the loop district, on expensive ground. Bids have been secured for the new building and necessary factory equipment has been ordered. The new foundry space will double the present space.

The present plant has been running night and day for many months without doing a penny's worth of war business and there is every expectation that the new plant will work to capacity as soon as completed.

A coke or charcoal fire is excellent for preheating if the size of the casting renders heating by a torch impractical. Charcoal is better than coke, since it gives a clean fire of about the right temperature. Once started charcoal burns readily with but little draft. If coke is used, care must be taken to see that the work is not allowed to become overheated and burned. An ordinary blacksmith's forge may be used for heating parts when no other method is available, but great care must be taken to see that the work is not burned on one side.

The Electric Arc Welding Process on Electric

A Summary of the Work Which Is Now Being Done and Which May be Untertaken in the Future

The application of electric arc welding to the maintenance of track and car equipment on electric railways, is one which has been pretty thoroughly developed in the past six years. This development has been due to the activity of a well known manufacturer, by the introduction and use of their apparatus, consisting of a rheostat which is used across the 550 volt trolley circuit. This apparatus has been used for arc welding both on the track and in the repair shop. The oxy-acetylene process has also been used extensively in shop work, although it has not been used on track repairs to any great extent. The electric railway operating men are, as a class, familiar with welding processes in general, since the thermit process has been used in the welding of joints for a number of years, as has also the contact welding process or Thompson process, in the welding of fish plates on joints. A large percentage of the important railways of the country, therefore, have had some experience with welding, and in general, the experience has been profitable. For this reason, electric railway men are favorably disposed toward the arc welding process. The application of arc welding on electric railway work falls naturally into two classes: that which is done under the supervision of the engineer of maintenance of way, which includes all track work, and that which is done under the supervision of the superintendent of shops, or master mechanic, and which includes all work done in the shop in the repair of cars, etc.

The welding on track work, up to the present time, has consisted practically, so far as the arc process is concerned, of the filling of cupped joints and the repair of switches and hard centers at cross-overs. The work has been done almost entirely by the use of the Indianapolis welder. Although this method has many objections, there are a number of operating men on street railways who claim that they have saved the cost of the apparatus in less than a week's operation.

The necessity for repairing a joint by the process arises from the fact that on track, where the cars pass in one direction only, the wheels in passing from one rail to the adjacent rail, pound out a cup on the second rail. This comes about as a result of a breaking down of the road bed which makes the joint rest on an insecure foundation. The constant pounding loosens the bolts which hold the fish plates so that in time the jar in passing from one rail to the next becomes noticeable to passengers. Once such a cup has been formed there are only two ways in which the difficulty can be eliminated; either the rail can be taken out and a new rail put in, or it can be repaired by the arc process. The former method cannot always be used, because if the track is in bad condition and all of the rails are pretty well worn the introduction of a new rail, which is not worn will make conditions as bad as they were before. The usual procedure where the arc process is not used is to take up all of the track where the trouble occurs and relay new rails. The expense of doing this, of course, is very high, since a gang of from twenty to thirty men is required to re-lay track without interrupting the service. The old rails can sometimes be sent to a shop, or in some cases, the work is done right on the ground, and the worn ends cut off, new holes drilled for the fish plates and the rails put in service on some other part of the line. The other alternative, of course, is to scrap the rails. There are many cases on record, where long lines of track have been kept in service by the use of the arc welder, for three or four years, in addition to the ordinary life of the track. The saving in cases of this kind, runs into the thousands of dollars and the cost of the equipment is a negligible factor.

Another defect which occurs on the electric railway track is known as corrugation. This does not occur at the end of the rail but may occur at any joint in the while length of the rail. The causes assigned to this difficulty are numerous, but the corrugated rail looks as if the metal on the top of the rail has been slipped into corrugation. In other words, it appears that the top layer of metal on the top of the rail slides on top of the rest of the metal of the head of the rail and forms what might be called wrinkles or corrugation. A car passing over a corrugated rail makes considerably more noise than when passing over a perfect rail and a distinct vibration and jar is felt by the passengers. Once a rail begins to show corrugation, the deterioration is rapid. In the case of corrugated rails and cupped joints, the metal electrode process is used to fill in the metal in the low spots. After the metal has been filled in, the excessively high spots may be ground off with a hand grinder; then the reciprocating grinder is put on that section of the rail and true surface obtained.

There is some variation in the practice of grinding off the excess metal. Some companies use the reciprocating grinder only, while others use both the hand grinder and the reciprocating grinder. The latter process seems to be preferable because it is undoubtedly the most economical. The rate of grinding with a reciprocating grinder is rather low, and where the filled in section is considerably higher than necessary an unreasonable length of time is required to bring it down to the proper surface.

The kind of electrode used depends a great deal upon the particular ideas of the person in charge of the work. So far as actual results go, the standard electrode which we use, or even Swedish Iron, will give results which are entirely satisfactory on ordinary rail section. The ordinary rail section may contain as much as .40% carbon while our standard electrode usually does not contain any more than .12% carbon. It would seem that the metal in the welded section, therefore, would be considerably softer than the rail. This however, does not seem to be the case. The best explanation seems to be something as follows: The cast steel which is put on the rail by the metal electrode process is not a normal cast steel, due to the sudden cooling at the instant it is deposited on the rail. It has been found that by forging metal so deposited, or, in other words, giving it mechanical treatment while it cools, increases its hardness to a considerable degree, so that after the repaired rail has been in service for a short time, the action of the wheels in giving the metal this mechanical treatment probably renders the metal considerably harder than the metal of the original rail. For high carbon rails, that is rails which contain as high as .90% carbon, and for manganese centers, the high carbon electrode should be used. One street railway company buys ordinary spring steel for this purpose which possesses about 1 per cent carbon. The results they obtain by the use of this steel on manganese centers and high carbon rails are perfectly satisfactory. The building up of broken tongues in switch construction is also a frequent application. The excess metal here, of course, is ground off by the use of the hand grinder.

There is An Objection to the Rheostat Method of Welding

In the first place, to weld with 150 to 180 amperes, it is

necessary to take from 82.5 to 100 K. W. from the line. This causes, in many cases, an objectionable line disturbance, and means that the cost of power for the work is a considerable item. A great deal of difficulty is experienced in making the proper contact on the trolley in order to operate one of these welders. In taking this amount of current from the trolley wire, burning of the wire frequently occurs and in some cases to such an extent that the wire is completely burned in two. If the wire is not entirely burned in two the arcing of the contact will materially weaken the wire so that in time of stress, due to sleet, etc. the wire will break at this point. There is a device on the market to prevent this but up to the present time it has not been used very much. Another serious objection to the rheostat apparatus is that when the operator is not welding, he has the full potential of the line between the electrode holder and the ground, so that if there is a hole in his glove, or he carelessly gets in contact with the bare cable, or bare parts of the electrode holder, he will get a full potential through his body. A good many serious accidents of this kind have occurred and a number of operators have been killed in using this equipment.

Another rather serious objection to the rheostat method of welding is that in track welding it is impossible to make the track positive side of the circuit. On all trolley systems the track is always made the negative side of the circuit. This is done to eliminate as far as possible the effect of electrolysis on water pipes running in the street with the trolley tracks. Since it is a well established fact that the greatest amount of heat in an electric arc is liberated at the positive electrode, it is particularly desirable to have the rails, which has the greater mass, the positive electrode. Better welding can be done with this connection than with the reverse. With the rheostat apparatus and the rail necessarily negative, the tendency is for the electrode to burn faster than the rail, so that globules of hot metal from the electrode drop on the cold rail and do not weld.

A variable voltage welder has many advantages over the rheostat apparatus. It is as readily portable as the rheostat apparatus. For welding at from 150 to 180 amperes the power taken from the trolley wire will vary between six and eight kilowatts, the difficulty arising from the burning of the trolley wire is entirely eliminated, because of the small amount of current taken, by the use of the motor generator set the rail can always be made positive and better welding done in less time. Owing to the low voltage used there is no danger of the operator getting a shock from coming in contact with the electrode holder.

The question is frequently asked regarding the motor-generator set: "What provision is made to take care of the voltage variation on the trolley?" On these units the following provision is made for this voltage vibration: The motor field poles are operated considerably below the knee of the saturation curve. The result is that the speed variation of the motor is not proportional to the voltage variation of the trolley circuit but is 15 to 20% less than the percentage variation of the voltage of the trolley circuit. The separately excited field is operated at a point considerably above the knee of the saturation curve of the pole pieces. This means that for a given variation of speed of the unit, there is not a corresponding variation of the current in the arc circuit, but something less than that variation. The net result of these two features in connection with the use of the Arc Stabilizer produces a current in the arc which is considerably more steady than it is possible to obtain with the rheostat apparatus. The current variation with the rheostat apparatus is in direct proportion to the voltage variation of the trolley circuit and for this reason the variable voltage equipment is considerably superior to the old type of apparatus.

The application of arc welding in the electric railway repair shop has not proceeded with the same rapidity as the application on track work has proceeded, although the saving which can be accomplished is quite as great. In this field the oxy-acetylene has probably been used more than the electric arc, although most companies who have used the arc process on track work have also done some repair work in the shop with it. The operation of electric cars over the track produces excessive wear on practically every part of the truck and underframing. The wear and tear on electric cars is probably greater in proportion to the value of the equipment than is the wear of a steam locomotive, resulting from its travel over the rails. The sudden starting and stopping with the consequent reversal of strains in all the members, means that at every point where the car is fastened together with rivets or bolts, excessive wear occurs. Where one part rubs over another the deterioration is extremely rapid. When a part becomes worn there are only two things that can be done; either new metal can be added and the part repaired, or it must be scrapped and a new part put on the car. It is obvious that the repair of the part by adding new metal produces a large saving. Where a part can be repaired without taking the car apart or taking the truck out from under the car, by the use of the welding process, an additional saving is made. Owing to the ease of application of the arc process, this can frequently be done and in this case the Master Mechanic credits himself with saving the price of a new part, less the cost of welding,—the saving in labor represented by the amount of time saved by not taking the car apart, and the additional saving resulting from keeping the car in service rather than having it lying idle in the repair shop.

The following parts are the principal ones which are repaired:

Truck Frames
Draw Heads
Brake Hangers
Spring Hangers
Body Bolsters
Motor Cases
Armature Shaft
Gears
Journal Boxes
Resistance Grids
Bolsters
Channel Iron Underframing

The only way in which the metal can be filled in the worn parts is by the oxy-acetylene welding process or by the arc process. The relative cost of the two processes is much the same as in other applications.

The metals encountered in the repair of cars include cast steel, cast iron, wrought iron, mild steel and bronze. All of these metals can be successfully handled in the railway repair shop. A large percentage of the work can be called "bench work" and preheating furnaces and torches can be used to a good advantage. While as a general proposition the arc process is not recommended on cast iron for commercial reasons, in this particular application it is safe to state that any piece of cast iron that can be welded with the oxy-acetylene process can be welded with the arc process. A rather unique application of the arc process is being made by the Baltimore Street Railways in the repair of bronze brushholders. The saving made by the application of the arc process on this job alone justifies the total expense for two operators. There is one peculiarity to the application of the process for the repair of cars that does not exist on any other arc welding application. There are many jobs of exactly the same nature since the car equipment is standardized to a large extent. This justifies a considerable amount of time spent in the solution of a given problem since that

it is certain that a number of similar jobs will reoccur from day to day.

The capacity of the equipment required for each operator is 200 amperes. While there are a few installations of apparatus where more capacity than this has been installed for one operator, the result of the experience of such shops makes it plain that 200 amperes per operator is the most economical amount of capacity which can be used. This permits the use of the machine for either carbon or metal electrode on any kind of a job that will arise. There are few cases where it would be necessary to couple two of the 200 ampere units together to get a higher capacity. It has been our policy to recommend the most economical amount of capacity to the customer rather than the largest amount he will pay for, since the former policy pays in the long run.

There are three men connected with an electric railway who should be interested in this kind of work, or rather three departments. While the title may vary with different roads, the division of responsibility is about the same in all cases. The superintendent of maintenance of way, has charge of the tracks. The superintendent of shops, or Master Mechanic, has charge of the repair of the cars in the shop. The president or general manager stands between the operating department and the directors who demand a profit from the operation of the road. The arc welder means lower cost of operation per mile of track and less labor for the superintendent of maintenance of way. The welder serves the Master Mechanic inasmuch as it cuts down the operation cost for car mile operated and speeds up the operation of his shop, and increases his output with a given number of men. The welder cuts down the cost of operation of the road for the general manager or president and enables him to show his directors a greater profit from the operation at the end of the year. It is a good proposition for all concerned.

THE OXY-ACETYLENE CUTTING PROCESS IN THE LOCOMOTIVE BOILER SHOP.

By B. Kopferschmidt.

The Oxy-Acetylene cutting device in the boiler shop is not intended to perform any operation that has not already been accomplished by some standard means; it replaces the hand or air chisel, and can be performed in any position whatever. The operator can cut towards him, away from him, horizontal, vertical, circular, overhead, and through double sheets without changing his position or turning the blowpipe.

Another important factor obtained by the oxy-acetylene cutting process is "Safety." It is a well known fact that the heavy sledging in cutting off rivet heads, nuts, or ripping sheets, have caused many an accident. With the oxy-acetylene cutting device all these accidents are eliminated.

The results obtained from the oxy-acetylene cutting device, over the mechanical devices, are safety, a decrease in time required, an increase in efficiency and a reduction in cost. Cutting with the oxy-acetylene blowpipe in the boiler shop can be done for half the cost over any other mechanical device, while the remarkable speed at which the work can be accomplished is a great time saver in the locomotive boiler shop. Any ordinary operator can cut for ten hours without getting exhausted, or stopping to resharpen the tool.

The most important gases that are used for cutting are oxygen and acetylene.

Acetylene can be substituted for other gases such as hydrogen, coal or illuminating gas, Pintsch gas, water gas, blaugas and gasoline.

The principle involved is about the same in all cases, with the exception of acetylene, which is more preferable in the boiler shop on account of its efficiency in cutting through rust or scale.

Oxygen, however, is the real factor in the successful application of either gas; it is the combustion agent used in cutting with the blowpipe.

The combustion is a chemical reaction between the oxygen and the body which burns in it. The product of the combustion is called oxide. In the same way as this rapid combustion, one can place what is called slow combustion. Oxidation of iron and steels by contact with the air (which contains one-fifth oxygen) is slow combustion. This slow combustion will continue, until the layer of oxide (rust) is thick enough to protect the rest of the metal from the action of the air. This reaction or oxidation increases with increase of temperature; thus iron and steel rapidly oxidize when heated to redness in air, and, of course, much more so in contact with pure oxygen. Therefore, if a jet of pure oxygen is projected on a previously heated iron, a narrow cut is accomplished. The oxidation commences at the part which has been previously heated to redness, because at this temperature, the reaction takes place readily. The combustion of this portion of iron disengages heat, a portion of which is absorbed by the neighboring part; this is sufficient to raise it to red heat, so that it in turn burns, and this reaction progressively propogated throughout the metal. The oxide formed has a much lower melting point than that of the metal and is detached, leaving the iron continually bare.

Therefore iron and steels are capable of being cut by rapid combustion of the metal under the action of pure oxygen. The operation consists of projecting on the metal previously heated to redness, a jet of oxygen escaping under a sufficiently high pressure. The oxide is driven away as it is produced, and the combustion extends throughout the thickness to be cut. It is only necessary to displace progressively and regularly the nozzle of the oxygen jet to obtain any desired line of cutting.

To accomplish this purpose a cutting blowpipe was designed, to produce a preheating flame, and to which is joined in a permanent manner a second arrangement for bringing the cutting oxygen with its regulation and its projection on the metal.

The chief point of a good cutting blowpipe is that these arrangements should be so combined that it will be hardly possible for them to get out of order, to be easily managed and above all, the economy of the oxygen consumption.

The equipment consists of one cutting blowpipe, two flexible tubes (one carrying the oxygen, and the other the acetylene), one oxygen constant pressure regulator with two gauges (the larger gauge showing the tank pressure, the smaller one showing the work pressure on the blowpipe), one acetylene pressure regulator with two gauges, one pair of light smoked goggles, one gas lighter and two wrenches.

Adjusting and Method of Cutting.

The oxygen regulator should be adjusted to the proper pressure for the size tip and thickness of metal to be operated upon, and to do so open oxygen tank valve, then open the cutting valve at the blowpipe, and turn adjusting screw to the right until the indicator on the small gauge will show the desired pressure. Then close oxygen cutting valve and send the oxygen and acetylene as for a welding blowpipe. Light and regulate the flame as near as possible in proportion to the thickness to be cut. Again open the valve for the cutting oxygen, and one will notice an excess of acetylene. It is therefore necessary to obtain the final regulation of the flame with the valve controlling the cutting oxygen open. This done, close the valve and the apparatus is ready to begin the work.

If compressed acetylene is used, adjust the regulator so the indicator on the small gauge will show 10 lbs. This pressure will take care of all the cutting in the boiler shop.

The cutting is commenced on one of the edges of the piece. The metal is heated by projecting the nozzle of the blowpipe on the corner of the piece and about ¼ inch above the metal to be cut, and when it is raised to redness, cutting is commenced by opening wide the oxygen cutting valve. The oxide of iron is thrown on the side at the beginning and underneath as soon as the cut has penetrated through the thickness of metal; only then when the oxide has gone through the metal, the blowpipe should be advanced regularly, so as to follow up the operation. If the operator advances the blowpipe too fast, the cut does not go through, and the oxide is blown on the sides or all around the blowpipe; in this case the oxygen cutting valve should be closed, and follow then the same preheating operation. If the operator goes too slowly the oxygen is wasted. However, an intelligent operator will quickly master the proper speed of advancement and follow up the operation normally. If a clean and regular cut is desired, one may use a blowpipe on rollers or a guiding support.

Applications.

In a general way the application of the oxy-acetylene cutting apparatus will save about 50 per cent over the mechanical processes. It is, however, necessary to guard against applying it to all jobs and especially those for which special tools have been designed. For instance the cutting off superheater tubes, where special pneumatic cutters have been made, the oxy-acetylene cutter will prove more expensive and not as easily adapted.

However, there is an enormous amount of work left that is practical and economical. Below are a few of the many jobs that are applied in some modern boiler shops:

Cutting out cracked or corroded portions of boiler, preparatory to patching.

Cutting out rivet heads preparatory to driving out rivets.

Cutting off new flexible stay bolts preparatory to riveting.

Cutting out pieces of smoke box ring preparatory to remove front flue sheet.

Cutting out smoke box sheet preparatory to setting cylinders.

Cutting iron and steel plates to any shape.

Cutting man holes and hand holes in boiler.

Cutting out old stay bolts and burrs in throat sheet.

Cutting out side sheets or crown sheets.

Cutting out flue sheets or door sheets.

Cutting out arch brick tubes including burrs.

Cutting out holes or excess metal in ash pan.

Cutting off sections of defected water scoop pans preparatory to welding new sections in.

Cutting out scrap particles in water space so they can be removed through mud plug hole.

Cutting out superheater unit ends in the flue, which cannot be pulled out.

Cutting out broken drills or taps in mud ring or sheets.

Cutting off holes in cylinder jackets.

Cutting up old condemned boilers.

OXY-ACETYLENE WELDING OF ALUMINUM.

Extracts from an article published in Machinery, February, 1916.

By S. W. Miller, M. E.

Aluminum is seldom used in its pure condition, as it is too soft, and in repair work only the aluminum alloys—principally in the form of crank-cases, transmission cases, and other automobile parts—are encountered. In the United States the usual alloy contains, at the present time, about 93 per cent aluminum and 7 per cent copper. In the past quite a number of parts were made from a zinc alloy containing approximately 90 per cent aluminum and 10 per cent zinc, but in foundry practice it was found that the alloy became brittle at a temperature just below solidification, so that many castings were defective on account of cracks due to shrinkage and had to be thrown out. The copper alloy, while not quite so strong at ordinary temperatures, does not have the tendency to crack that the zinc alloy has; this is fortunate for the welder, as cracking is likely to occur in many cases, particularly in a complicated piece, due to the contraction strains.

A zinc alloy is generally identified by the condensation of the white zinc oxide on the cooler part of the casting during welding, and it may be necessary to cut or break the casting at some place where it can be repaired without bad contraction strains, in order that the weld in the original break may be made. It is not very often that the zinc alloy is encountered at the present time, although when it is, it may cause the welder a great deal of trouble and in some cases it may be impossible to do the job. It is necessary with such zinc alloys to preheat the whole piece to as high a temperature as is safe, and handle it very carefully.

Sometimes it is advisable to have an extra man to help in handling the work, as if the piece is dropped or jarred it may be damaged considerably. When the weld is rather long, it is sometimes necessary to use two welders, beginning at the center and working toward both ends, so that the variation in temperature and the resulting strains are not so great as they would be if only one torch were used. In the case of a copper alloy, this brittleness does not exist to so great an extent, and it is not necessary to take such great precautions, but in all cases where the defect extends into the body of the casting, it is advisable to thoroughly preheat and handle it carefully. Aluminum oxidizes readily, particularly at high temperatures, and as the oxide melts at a much higher temperature than the metal, and is heavier than the melted metal, it is likely to become mixed into the melted mass and produce a poor weld.

Flux for Aluminum Welding.

It is frequently stated that it is impossible to make a sound weld in aluminum without a flux which will destroy the oxide. Aluminum oxide is exceedingly resistant to the action of any acid or alkali even at a high temperature. Therefore, the flux used in welding must be very severe in its action. The danger in using some kinds of flux is that an excess, unless it is removed in some way, will damage both the metal in the weld and that surrounding it. The writer has seen this action occur a number of times. It is true that the welding was done by those who were not very skillful, and who did not realize the importance of using the minimum amount of flux and brushing off the surplus in boiling water afterward. Another objection to the use of flux is that the surfaces to be joined must be thoroughly cleaned, because the flux is designed to remove oxide of aluminum and not grease and dirt, which are always present in repair work. The time occupied in cleaning the dirt out of the crack or break is considerable, and in most cases the weld can be made without flux in the time required to clean the piece thoroughly. Again, it is not possible, even by the use of a flux, to avoid some porosity in a weld; and further, in the best aluminum castings there may be, and frequently is, greater porosity than in a well puddled weld In view of these facts, the author doubts the advisability or necessity of using flux.

The method used in the writer's shops in the case of cast aluminum is to thoroughly puddle it without any preparation, except wiping off the dirt and grease. There is an additional advantage in not making a V at the break in the case of aluminum, which is that the sections are generally thin and the contraction of the weld is better resisted by the piece being allowed to remain its full thickness, although of course the contraction is not entirely avoided.

Procedure in Welding.

A puddling rod has been found most satisfactory, al-

though other shapes are used. In all ordinary cases, the metal should be melted with the torch until the bottom of the crack is reached, using the puddling rod all the time, and the metal should be allowed to sink below the lower surface of the crack, forming beads. These beads can be removed afterward, either by the torch and puddling rod, or by chipping or filing. In welding thick pieces, the work must be done from both sides. In this case too much of the welding should not be made on one side at once. It is better to weld, say 2 inches, on the first side, and then turn the work over and finish welding the 2 inches on the other side, then proceed along 2 inches further, and again turn the piece over and weld 2 inches more on the first side. The reason for this is that aluminum is somewhat brittle near the welding temperature, and cracks are likely to develop, particularly in a long weld, if all the weld is made on one side first, and then finished on the other. On account of this brittleness, a weld in aluminum must be made quickly. Slow work is fatal to good results. It is occasionally necessary in a long weld to have two welders start at the middle of the crack, and work toward the ends, to avoid shrinkage cracks.

On account of the tendency of aluminum to oxidize, it is advisable to use a flame with a slight excess of acetylene. Too much metal should not be added from the welding rod at one time, and what is added should be thoroughly puddled with the welding rod while it is being added and afterward, until there is a melted pool at that point and the proper union has been made with the surrounding metal. The surplus metal should be scraped off with the puddling rod while in a pasty condition, as it contains much oxide, and the welder should be sure to make a good junction at the edges of the weld. The manipulation of the torch with one hand and the welding stick with the other, the latter having to be laid down and the puddling rod picked up at frequent intervals, is rather difficult. Some welders find it easier to hold the torch in the left hand, although ordinarily right-handed. This is the case with the writer; others find the opposite way to be the easier. In either case, the trouble is caused by the difficulty of working with both hands at once.

When adding the metal from the welding stick, it should be continually rubbed into the melted pool in order to avoid oxidation and to work the oxide to the surface. A beginner should weld and break quite a number of test pieces before he attacks any important job. He should not be discouraged at the result of his first attempts, which are certain to be unsatisfactory, much more so than with any other metal, although aluminum is the easiest metal to weld, after the difficulties in handling it have been overcome.

Examples of Aluminum Welding.

The best method of replacing a broken lug on an aluminum manifold is as follows: It should be laid on the table and a small weight put against the lug to keep it from moving. No larger tip should be used than is absolutely necessary, in order to avoid melting the lug, this being likely to occur if care is not taken. The cold table will tend to overcome part of this trouble, as it conducts an excess of heat away. After the back of the lug is welded (and the weld should be made almost entirely through from this side), the inside should be finished, being sure to remove all the crack.

It is not possible in the case of lugs on aluminum manifolds to use the block and clamps used in the case of cast iron, as aluminum would crush under the clamping strain. Immediately after welding, the lug should be tested with a straight-edge to be sure that it is true with the rest of the face. If not, it can either be bent down, or a little metal added where it is low.

In the majority of cases, and especially in the case of small lugs, it does not pay to put back the old lug, and it is good practice to build up a new one. An expert welder can build up a lug without any assistance from forms, etc., but the beginner had better make a mold out of a thin piece of sheet metal of the height and shape of the lug, and hold it in place with a small weight, filling up the mold. The body of the manifold should be raised about 1/32 inch from the table with a piece of a hacksaw blade, or something similar, to allow stock for finishing. It is necessary in this case to be particularly careful to get a good union between the new metal and the old. * * *

It might be well to mention here the necessity of obtaining good castings for such repair work. It will not do to use the material frequently furnished by small foundries, which they claim to be aluminum. The writer uses nothing but No. 12 metal, which can be purchased from aluminum manufacturers in pigs. No scrap whatever is permitted, nor any other alloy. In case of serious difficulty in obtaining castings of the proper quality, or if it should be necessary to send a long distance for them, it is recommended that a small crucible be obtained and pig metal melted in it in a small furnace designed for the purpose. This furnace can be connected with any flue ordinarily used in a stove. It is not satisfactory to melt this metal in an iron ladle, as it is too much exposed to the action of the air. As soon as the metal is melted it should be covered with a layer of fine charcoal to prevent oxidation as much as possible. A small flask made of wood and some fine molding sand are easily obtained, and will be found very convenient for many purposes.

Care should be taken in melting aluminum not to get it too hot, and it should be well skimmed while pouring to prevent the oxide from passing into the mold. The shrinkage of aluminum is considerable, about 7/32 inch per foot, and the pattern should be well wrapped in order to allow for this, or else the necessary stock should be added to the pattern to take care of it. A novice will probably have some trouble at the start, but a little care, and if possible, the observation of the various processes at some foundry, will help a great deal. Of course, a greater amount of pig metal should be melted than is needed for the casting, and any surplus should be poured into a mold or into a hollow made in the sand pile. It should not be left in the crucible.

A SAFETY FIRST SUGGESTION.

Editor: It is a well known fact that the emergency oxy-acetylene cutting outfit has proven a great success to fire departments, steamships and railroad wrecking trains.

In case of a wreck or falling over an embankment for example, the steel cars would have to be cut to enable the passengers to get out. I would suggest that all such cars be equipped with 1/16-inch sheet asbestos in one hundred foot rolls for the protection of such passengers from the multitude of sparks produced by the cutting operation.

The imprisoned passenger in his berth could wrap himself with the asbestos and be absolutely protected from the sparks. The same protection could be given the passengers in steamships.

The emergency fire department brigade is equipped with a cutting apparatus and in addition to their oxygen helmets they should have a few rolls of sheet asbestos for their own protection or for some imprisoned people in burning buildings.—B. Kopferschmidt.

WHERE IS HARRY G. ALLEN?

WANTED—If Harry Gordon Allen, gas and welding engineer, will forward his address to "The Welding Engineer" he will hear of something to his advantage.—E. W. T.

OXY-ACETYLENE SOLDERING OF ALUMINUM

By J. K. Smith.

A new process has been developed recently for working aluminum, which differs materially from ordinary welding methods, the new process being in use in the shops of several well known manufacturers of automobiles. This process is called oxy-acetylene soldering and may be said to be to aluminum what brazing is to malleable cast iron. It is much easier to solder aluminum by the oxy-acetylene process than it is to weld in the usual way, and many of the dangers and difficulties of the older system are eliminated. Every welder will admit that a very large percentage of the failures in welds are caused by inexperience in preheating. When using the new soldering method it is unnecessary to preheat, hence many of the difficulties of the old system are at once removed.

The process of soldering aluminum by the oxy-acetylene method enables the operator to avoid all of the troubles occasioned by oxide, and the metallic substance that is melted under the action of the blow-pipe is absolutely clean. That is to say, free from impurities. However, the success of the process depends largely upon the proper composition of the solder, the tensile strength of which is about 11,000 pounds per square inch in the cast state. This solder is of my own manufacture and is being used daily by one of the leading motor car manufacturers, where I am employed. The mechanical properties of the solder are those of the aluminum cast metal.

The process of oxy-acetylene aluminum soldering is very valuable for aluminum production work, especially in the manufacture of aluminum crank cases and other automobile parts. The companies using this process realize a saving of thousands of dollars weekly in reclaiming defective aluminum parts.

The method of welding aluminum with pure aluminum, as is attempted in many cases, would be impracticable because it's slow labor and because of the great expense to be considered where hundreds of castings are to be repaired daily.

Method of Soldering.

As a general rule, the pieces to be soldered are prepared in the same manner as for welding; that is to say, edges are polished, cracks beveled when thickness exceeds ⅛ inch, etc. A blowpipe of very low delivery is used and before joining the pieces it is necessary to coat both surfaces with aluminum solder. For instance, where it is necessary to add ¼-inch stock on a cam bearing, the bearing should be heated all around until all the oil is burnt off, or until a yellow color is visible. Then use a wire brush to clean off all impurities, or until the bearing has taken on a white polish. The flame is then played around the bearing and the operator, with a suitable bar of aluminum solder, rubs the bearing occasionally until the solder melts. At this point (about 600° F.) the flame is removed from the bearing and the bar of solder is rubbed gently on the bearing until the solder melts freely. A wire brush is then used to rub the solder in the bearing until a bright silver color is attained.

It is necessary at this point to have some of the solder melted in a small pot, and it should be as nearly as possible in the form of putty. Then, with the aid of a paddle, as much stock as is needed can be taken from the pot and put into the bearing. By this time the metal is somewhat cooler, but yet it is workable. With the aid of a round piece of wood, or fibre, the metal is worked around the bearing to the desired size or shape, until the metal is solidified. However, the operator must be careful in applying the stock from the pot to the bearing to have the latter at the same temperature as the melting point of solder. Usually the operator becomes familiar with the proper temperature after a few operations.

Soldering of aluminum can be applied for all permanent joints on articles of this metal. If well executed the joining line has no defects and consists of a composition of pure metals, so combined that the joint has almost the same mechanical strength as that of pure aluminum. Work to which the oxy-acetylene soldering system is especially adapted includes the making of bottles and light cans, tanks, crank cases, transmission cases, differential carriers, pump bodies, steering wheels, motor fans, automobile bodies, kitchen implements, etc.

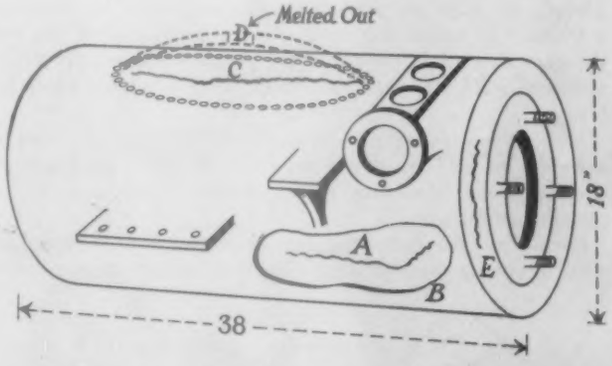
STATIONARY GAS ENGINE.

Editor: Sketch herewith shows stationary gas engine with a crack in the cylinder at A about 15 inches long. B shows section of water jacket about 45 inches around cut-out to allow access to crack A.

C shows crack in another section of the water jacket about 20 inches long, which was covered with a patch. Sixty-eight ¼-inch holes were drilled in the jacket to fasten patch securely. Upon taking off patch previous to welding, crack was discovered through entire length of screw holes above crack C. E shows crack in head 12 inches long. Welded previously by another concern, but crack A opened again, probably due to poor welding, and contraction not being properly taken care of.

This is not considered a large job by any means, but as it turned out to be one of the most peculiar jobs ever experienced by the writer, it is thought it will probaly interest others.

Brick furnace was built around outside of cylinder with crack A in position to weld. Two gas preheating torches



were employed to bring the bore out of the cold stages, then charcoal fire was lit and the whole casting allowed to reach proper expanding point at the same time. As the writer does not believe in allowing cylinders to become bright red, (unless unavoidable) two welders are used to make weld as quickly as possible to avoid any one section becoming too hot. If weld is long, means are taken to deaden the fire for the time being.

On crack A, two welders worked from ends into center. Then patch B was placed in position, and each welder finishing where the other had started.

Upon turning over, it was found that section around crack C had become so hot, that as the metal surrounding the crack expanded, it caused part cracked at C and through holes to raise 1 inch, as dotted lines show.

This was due to cracked section being so small in comparison with surrounding area, that as the metal expanded, it took the easiest course which naturally was to raise, as it had no restriction on either side. Section was then melted out at D one inch long, and as this section was up preparatory to welding, part of the asbestos covering was removed to allow rapid contraction. Two blocks of iron each weighing about twenty pounds were placed on each end where metal was melted out. As the outer metal contracted, these weights

helped to push raised sections downward, until the two ends met.

The raised sections went down within an eighth of an inch of their original position and could go no farther owing to the outer area being expanded, which in conjunction with the ragged edges made a good fit under these circumstances impossible.

With two welders working on this section, all welding was started at ends and finished in center at one time.

To avoid having to disturb cylinder in fire, by standing on end, the crack in head was welded in vertical position as shown. Cylinder was then turned over with crack C resting in bed of the fire, on account of this being the coolest part of the cylinder. Left in this position for about fifteen minutes, then blow-torches were removed, and charcoal fire banked, covering entire casting with sheet asbestos, allowing section around C to regain some heat, while section B was contracting, thereby assuring the final contraction to be even.

Allowed to rest in this position for thirty-six hours, after which the weld was ground up, tested, painted and bore wiped with oil.

Crack A was welded in such a manner that it was not necessary to bore after welding, as the cylinder was taken from the welding shop and mounted ready for work, showing no signs of the ordeal through which it had passed except where welds were ground, this was left ¼-inch high.

J. B. Diehl.

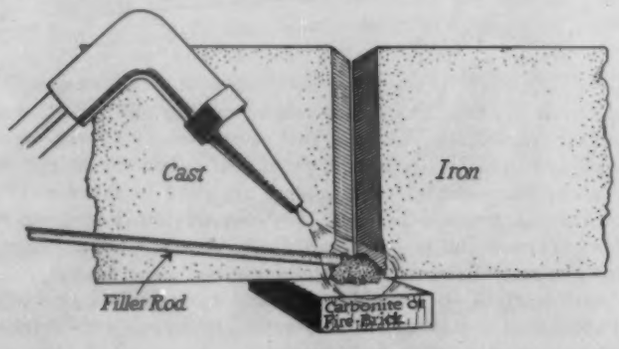
VERTICAL WELD ON CAST IRON

Editor:

There appeared in the August issue of *The Welding Engineer*, on page 38, a sketch and description of "Repairing a Planer," in which you state that the welder could not make the cast iron stick, owing to the break being nearly vertical, although weld was made as usual, using a carbon block as a form.

Until a few years ago it was considered quite a feat for a welder to perform a vertical weld on cast iron, but as the operators are becoming more efficient every day, it only remains as history.

Owing to the fact that cast iron loses its adhesiyeness when reaching the melting point, it is rather difficult for the



beginner to make an angle or a vertical weld without considerable practice.

In making a vertical weld on cast iron, welding should always be started at lower end of break and worked toward the top. Otherwise the molten metal would have a tendency to run down and cover sides of groove not welded, making an unreliable weld. It isn't necessary for an accomplished operator to use carbonite blocks in making vertical welds or in building on sections, unless to save holes, or some places where finishing isn't practical, as it is possible to bridge across openings with cast iron, the same as steel, without using forms, although on a heavy weld greater speed is attained by using a carbonite block to get the start.

Care must be taken to keep casting at a good welding heat, otherwise the operator will be troubled with blow holes upon finishing. A fairly good sized tip should be used, holding torch at such a distance that the small cone at end of tip will be from one to three or four inches away from the metal, according to size of casting and tip. In welding any metal, the proper procedure as determined by the writer is to use a tip one size larger than is customary. Do not force the flame, but rather have it large and slow, as the metal can be controlled more easily, resulting in better workmanship.

In welding a piece approximately 3 inches thick, where groove can only be cut from one side the result will be a space of 3 inches at outer edge of groove, tapering to probably 1/16 inch at bottom of groove. For those who are not adept, the proper method would be to place a carbonite block, or a fire brick, when carbonite is unavailable, directly under groove where welding is to be started. (See sketch.) In using fire brick care should be taken to select one with a comparatively smooth surface, otherwise the cast iron will incorporate in the cavities of the brick, causing the operator trouble when washing surplus metal off.

The metal is then melted out of groove from bottom of crack, adding flux to assist the flow over the form joining the lower edges together. Torch is then held the required distance from the weld, to assist the operator in controlling the metal. After getting the start it is practically a short horizontal weld, although the operator must exercise care in building the outer edges, otherwise the metal would run away.

This distance can be determined by the action of the weld zone metal and the filler rod. The idea is to just keep metal hot enough to barely flow. If the heat is too intense the metal will become too fluid and have a tendency to run away. The best method is to form outer edge of weld first, then puddle and add new metal inside, making sure that the outer surface of weld is the right height before going ahead, as it is quite difficult to build more metal on under these circumstances and make a nice finish.

The operator should watch the metal carefully. If he cannot control the metal it may be assumed that he is either holding his torch too close to the weld, or he is holding the torch in the wrong position to control the metal.

The outer surface of weld should be made a trifle high, the surplus being melted or washed off (as the welder would say) making a smooth workman like finish. If the weld is over six inches high this washing process should be employed every few inches, otherwise, after say a nine inch weld was completed and the operator started to wash at the tip, upon reaching the lower end the cooler metal of the weld zone would chill the washed metal as it melted, causing blow holes.

In building on lost parts, such as the "planer" metal would be melted at lower end of break and new material barely melting, would be pushed into break, gradually building farther across and to the desired height, after which the surplus metal would be washed off.

It should not be assumed that a weld of this nature is not a first class weld. When the operator grasps the idea of controlling his metal it is quite possible to puddle the metal thoroughly, finishing with a smooth, close grained weld "that will stand up."

In building the outer edges of a vertical or angle weld, with or without form, the operator, after bringing weld zone to the fusion point should hold the torch with the tip at an angle of from 45 to 90 degrees flame pointed toward bottom of groove or shooting upward. The rod is then held in front of flame, taking care that flame is played on necessary parts to secure all around fusion. As soon as metal starts to melt, rod dipped in flux should be pushed into edge of weld and torch manipulated in such a manner to flow metal together well, but at same time to keep it where it belongs. If torch

(*Continued on page* 31)

Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch, and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

Editor:

We have heard something to the effect that it is possible to remove the buckles that occur in welding rather light gage sheets together, and that this can be done by a certain way of heating and cooling the material at certain points. One of our operators saw this done with heavy plates, and we would like to know if you have any information or can obtain it, for we are sure it would be of much interest to your readers, as well as ourselves. Butler Mfg. Co.

Answer:

It is difficult, of course, to give definite instructions in this case because deformations vary with the nature of the metal, thickness, form and size of the sheets to be welded. However, the best method of removing buckles is to remove the cause. When buckles do occur heat opposite portions, so that the effect of expansion in each sector is counterbalanced by that produced immediately after. If the buckle occurs in the interior of the vessel it is sometimes necessary to heat opposite portions in succession, advancing the heat toward an end where the metal can finally expand freely.

Buckling in welding thin sheets can be avoided entirely, however, if the sheets are properly prepared or adjusted previous to welding. Indeed it is much easier to avoid buckling than to remove them. In welding thin sheets under 1/16 inch if the edges have been arranged parallel they will always buckle, on account of the separation and warping caused by expansion. The best method to overcome this is to separate the edges before commencing to weld, the separation being in the form of a V, the edges of the sheets being brought together only at point where welding begins. The separation should amount to from 4 to 6 per cent of the distance to be welded. The longer the seam the greater the separation. Of course the thickness of the sheets should also be taken into consideration. For a short distance the operator will notice a further expansion, but the crack will shortly begin to close and, if his calculations are correct, at the finish of the weld the sheets will be without a buckle.

Another good method is to bend up a small flange on sheets, edges of flange being butted together. The flanges thus welded serve not only as a welding rod, but have a tendency to hold edges of sheets in place, avoiding buckling. After welding the line of weld may be smoothed out by hammering. A detailed and illustrated article on sheet metal welding is in preparation and will be published in an early issue.—Editor.

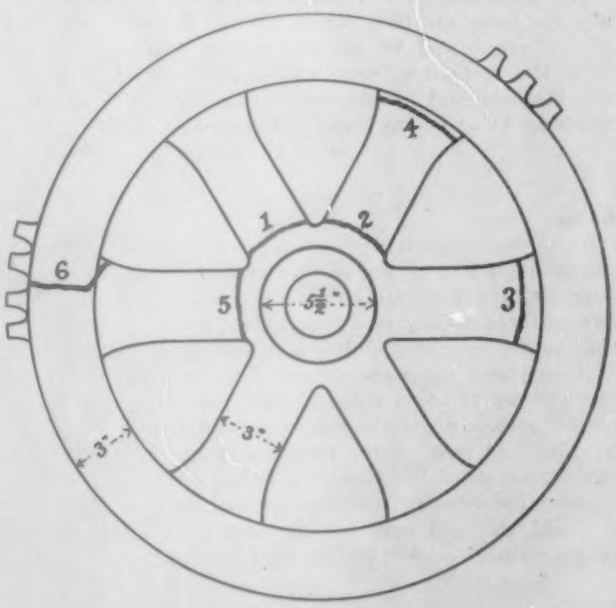
Editor:

The writer is sending a rough sketch of a machined gear wheel that has caused us trouble in welding the rim. We have welded a great number of wheels of same character and had no trouble, but we are up against this one. Can you help us out? If not asking too much we would like an early reply as parties are waiting. We made all the spoke welds as numbered 1-2-3-4 and 5 having no trouble. We then made No. 6, and when completed the weld did not come together. It left a space of ⅛ of an inch. We broke the joint and our preheating will not bring it together close enough. We built a charcoal fire around rim and a light fire at hub, enough to warm it up. Where is our mistake?

Western Welding Works.

Answer:

To close the rim ⅛ inch or to its original size, it is absolutely necessary to cut out ⅛ inch metal at No. 6, thus giving the rim a free chance to expand. It is natural, that after heating the wheel in five different places that it will not return to its place accurately. Moreover, if the grain in the fractured metal will not fit to perfection, it will always



spring away about ⅛ inch. Therefore, by cutting off ⅛ inch at the fracture and with a proper heat treatment, the rim will close, less the ⅛ inch that was cut out.

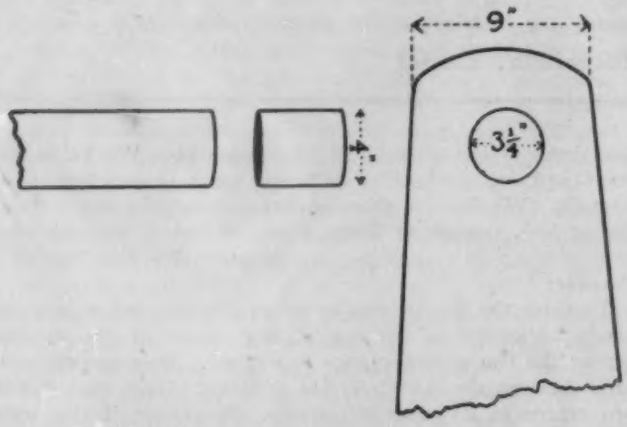
The proper heat treatment is as follows: Bevel to a 45 degree angle on both sides at No. 6, so that the wheel will lay horizontal on a brick platform surrounded with fire bricks. Heat the outside rim to a cherry red with an oil burner, if possible, on the same principle as a fire heater; the hub and spokes should not be heated. The rim will thus expand and close at No. 6. Immediately as the rim closes the desired space, weld one side of the bevel, then presuming that the rim is still cherry red turn over and weld the other side. It is then necessary to remove the oil pipe burner and to fill the furnace with charcoal, covered with sheet asbestos, and preheat the whole wheel to a cherry red and let it cool gradually. This final preheating is to remove any strain left in the iron caused from welding the spokes.

If an oil burner cannot be obtained the outside rim may be preheated with charcoal until cherry red.—Editor.

Editor:

We are enclosing a rough sketch of a novel use that we placed our welding torch to.

This sketch is of a large crank disc on a 250 horsepower engine. The old crank pin having come loose it was necessary to re-bore the hole and shrink in a new pin. Heretofore this operation of heating this on similar jobs has taken all the way from 3 to 4 hours, being accomplished on a charcoal fire, with danger of melting out the main bearings.



We accomplished this job with a No. 10 torch in just 35 minutes from the time the torch was lighted until the pin was in place, and we allowed almost 1/64 for expansion. With this method we were able to hold the heat away from the bearings and saved considerable time. Thinking that this may be of use to some one else, we remain

Wm. O. Keefe Engineering Co.

Editor:

In welding cracked or broken cylinders or any casting requiring a pressure of any kind on same, to make sure the weld is perfect and there are no cracks, holes, or leakage, a lot of time is saved making pipe fittings, etc., to put on air pressure, plug up all inlets and outlets with wooden plugs, fill cylinder or water jacket with water through hole remaining open, leaving an air space of about one-half inch, then drop in a piece of calcium carbide about the size of a small pebble. As soon as it is dropped plug up the remaining hole. This generates a pressure of about 20 pounds per square inch which is enough pressure for cylinder. If there are any flaws or blowholes in the weld, this will soon tell, for castings or tanks requiring greater pressure calcium carbide must be put in accordingly.

E. Baumann.

Answer:

We consider this to be an extremely dangerous practice, one which all parties interested in welding should avoid.

The method suggested by Mr. Baumann gives no certain guarantee as to what pressure might be produced in the water jacket. A careless workman might not watch the level of his water or be very particular about the size of the piece of carbide he put in. A sufficiently high pressure might be created in the water jacket to cause it to fly—the flying metal would be apt to cause injury; the escaping gas might cause an explosion.

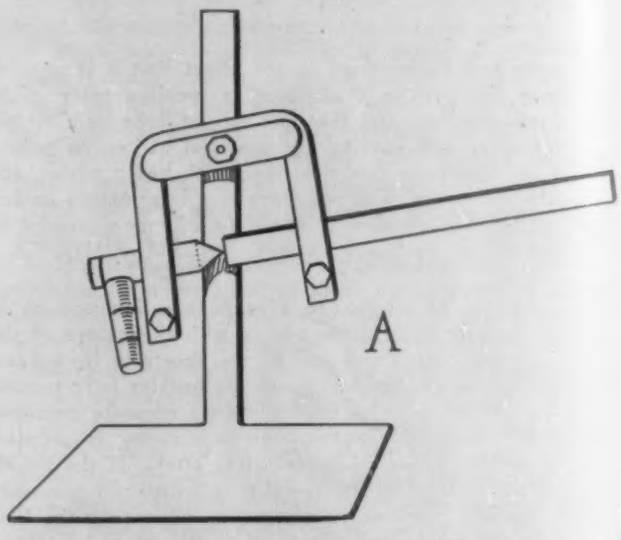
Our correspondent does not seem to appreciate that he would not have pure acetylene in the space over his water, but a highly explosive mixture of air and acetylene.

There are several other features of the proposed method of testing which are objectionable and warrant this method of testing being discouraged. Hydraulic pressure should always be employed for testing welded joints. In most localities the pressure on the water supply is sufficient to test out welds on castings. Where welded parts require a high test pressure a hydraulic test pump should be employed.

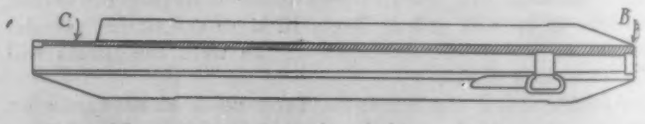
Editor

Editor:

In the manufacture of machine guns, provisions are made for radiating the heat away from the barrel, thereby prolonging its life, and retarding the harmful effects of crystallization. This problem of radiation is solved by surrounding the barrel with an aluminum extrusion, analysis 85 per cent aluminum and 15 per cent copper, with traces of silicon and iron as impurities. In the manufacture of these radiators, the workmen frequently spoil their work by milling slots too deeply, or at times, an inexperienced man will drill a hole in the wrong location. When the inspector in charge discovers the mistake, he sends the spoiled work to the Salvage Department, which in turn sends it to the Welding



Department to have the hole filled in, or correct whatever deficit may exist, due to improper machining. Since the melting point of aluminum is comparatively low to that of the temperature of the oxy-acetylene flame, one is inclined to believe that the radiator can be repaired with little or no difficulty—but the aspect of conditions change when one sees that the welder is unable to flux the metal of the radiator so that it will coalesce with the molten metal of the welding rod. At this stage of our work, we encounter a stumbling block which for the time being seems insurmountable; but as we have 500 radiators to reclaim by this method, it is necessary to devise means that will alleviate our difficulty. Many experiments are tried, but the successful one interests the reader most, and that is the one I will describe.



Due to the high conductivity of aluminum, and the excellent manner in which the radiator performs its function, it is mandatory that the heat be supplied to the radiator faster than it is radiated away. This is effected by directing the flame of an ordinary Bunsen Burner "A" against one end of the radiator "B," and executing the weld at any point "C." With this method of procedure it is possible to successfully weld an aluminum radiator, such that is used on the modern machine gun. Without using the Bunsen flame in connection with the work, it is impossible to repair the radiator by the welding process, because the acetylene flame can be directed against any part of the radiator without affecting same. It is somewhat of a strange coincidence to see a welder direct a 6,300° F. flame against a

Quality = *Guaranteed* = Quantity

Write US About Your Acetylene Supply

Commercial Acetylene Welding Co.

ATLANTA, GA.
AURORA, ILL.
BOSTON, MASS.
BOUND BROOK, N. J.

80 Broadway, New York City

PEOPLES GAS BUILDING
CHICAGO, ILLINOIS

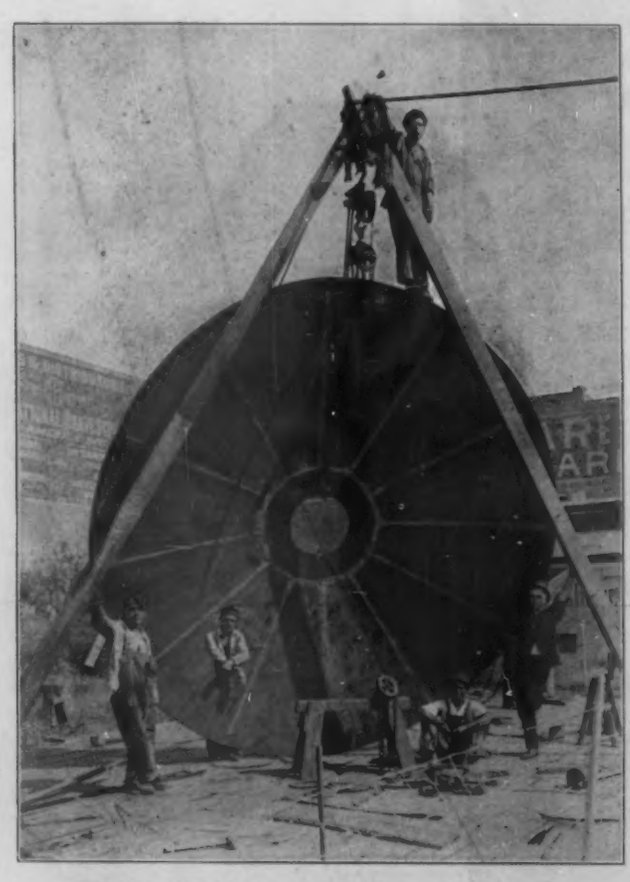
EAST DEERFIELD, MASS.
TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

piece of aluminum without melting it. However, this is what actually happened in a large munitions plant in the East.

Victor E. Hillman.

Editor:

We are sending you under separate cover a photograph of a large retort head which was cut and welded by one operator in three 9-hour days. The reason this head was welded instead of riveted was because of the resisting power of a welded seam over a riveted seam. The head is used where there is a very strong iron eating acid, and the welded seam is more durable than a riveted seam. This head is for temporary use only, as large sheets of copper cannot be secured for 90 days. This retort blew up a short time ago and the owners have discovered that a welded seam will last longer than a riveted seam. They have some welded tanks and some riveted tanks and since the explosion they have



Eighty-six Feet of Welding in Large Retort Head.

cleaned these tanks out, at which time they found that the riveted seams were almost gone, while the effect on the acid on the welded tanks could hardly be noticed. This head is 15 feet in diameter and 3/8 inch thick. The center panel is 4 feet in diameter. There was about 86 feet of welding. The center panel was laid and well dished up, then one of the long panels was welded to center panel. The next panel was brought up and welding started at center ring, leaving foot of long panel open at bottom about 5/8 inch and welding down, leaving 4 inches unwelded until bottom was flanged, then bottom was finished and so on around same. Then the inside was gone over to smooth up same and braze in copper ferrils in holes left for same. Work was done with Henderson-Willis outfit.

Pensacola Welding & Cutting Works,
Joseph Lawlis.

Editor:

We are somewhat new in the jobbing of Welding Metal supplies and would appreciate it very much if you could give us some information, which you evidently are able to do.

There are a great many welding metals being sold, these metals being used for welding, filling and brazing, and what we desire is a word as to what these various metals are best adapted for and in connection with what metal they are used for welding. If you could state in a word what the following metals are best adapted for we would appreciate it exceedingly and hope we are not asking too much in this connection. The metals are as follows:

Phosphor Bronze
Tobin Bronze
Manganese Bronze
Brass Spelter Wire
Nickel Steel
Vanadium Steel
Norway & Swedish Iron
Common Cast Iron

What is used for welding Chrome Nickel Steel and Brass Castings?

Enclosing a stamped envelope for your reply and thanking you in advance for any information you may see fit to give us along this line, we remain, M. & E. Co.

Answer:

Below we name the most commonly used welding rods, and their uses.

Name of Welding Rod.	Its Uses.
Phosphor Bronze	Hard bronze bearings, cocks, valves, steam whistles and all such strong bronze castings or heavy bearings.
Tobin Bronze	Injectors, lubricators, rod brasses, bushings, brazing of cast iron and malleable iron and all brass castings.
Manganese Bronze	Propeller blades, pumps, bells and all very strong castings.
Brass Spelter Wire	Brass tubes, brazing of bronze or brass to copper, copper to copper, galvanized sheet iron and light sheet iron.
Nickel Steel	Bicycle tubes, shafts, axles, hard steels, vanadium steel and all steel castings.
Chrome Nickel Steel	Safes and all hard steels.
Norway or Swedish Iron	Sheet iron, boilers, locomotives or automobile frames, wrought iron and mild steels.
Gray Cast Iron	All cast iron, steel to cast iron.
Vanadium Steel	Uses for Nickel steel.
Brass Castings	Uses for Tobin Bronze.

Editor.

Editor:

The illustration at the top of the attached sketch shows a high-speed steel tap, broken as shown in the illustration in the middle. I first beveled the job as shown in center and welded, using drill rod as filler. The weld did not hold, but broke, as shown by line in illustration. I then prepared job, as shown in third illustration, filling with nickel steel. This weld also failed to hold. Can you, or any of your readers, suggest the proper method? I would like to know what the experience of others has been. G. L. G.

Answer:

In the June issue Mr. B. Kopferschmidt in an article relating to welding high speed and hard steel, said:

"Preheat the high speed steel in a smithy furnace to a dull cherry red, then build up 1/8 inch metal on the side that is

Abnormal Business Conditions—
What We Are Doing To Meet Them

Chapter E

Maintaining Service Under Difficulties

During the Past Twelve Months—

Linde Service has been put to this sort of a test.

Big customer A—last year was using 20,000 cubic feet of Linde Oxygen a month.

Without warning to us he increased his orders in a few weeks, to 100,000 cubic feet a month.

Big Customer B—Jumped his orders 600 per cent in four weeks without advance notice to us. His requirements now demand 20,000 cubic feet of Linde Oxygen a day.

Big customer C—Using 31,000 cubic feet a month in October, was ordering 160,000 cubic feet a month in April without advance notice to us.

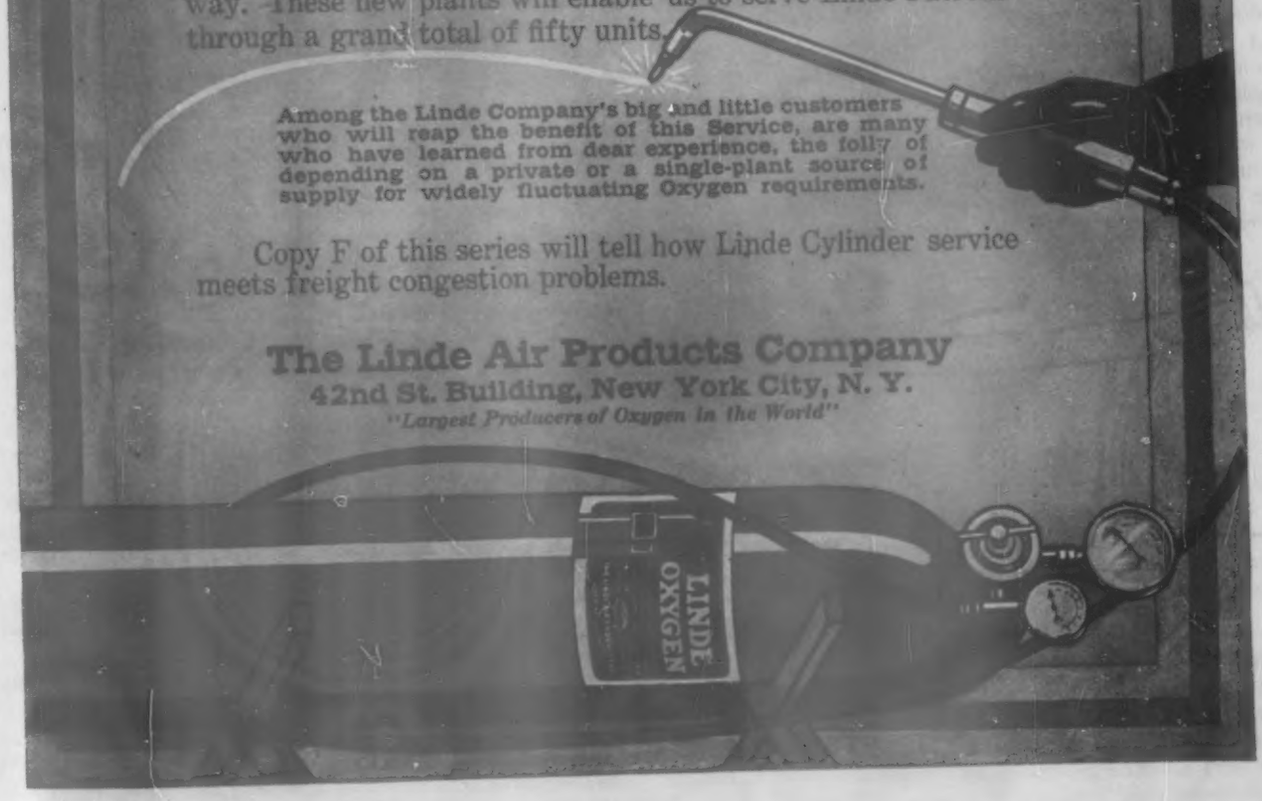
These instances are typical. They were duplicated on a smaller scale in every section we serve.

In connection with the task of meeting these abnormal demands, we have increased our stock of cylinders over 100 per cent within 12 months. Also, we have built during the same period, six new factories and have six more under way. These new plants will enable us to serve Linde Patrons through a grand total of fifty units.

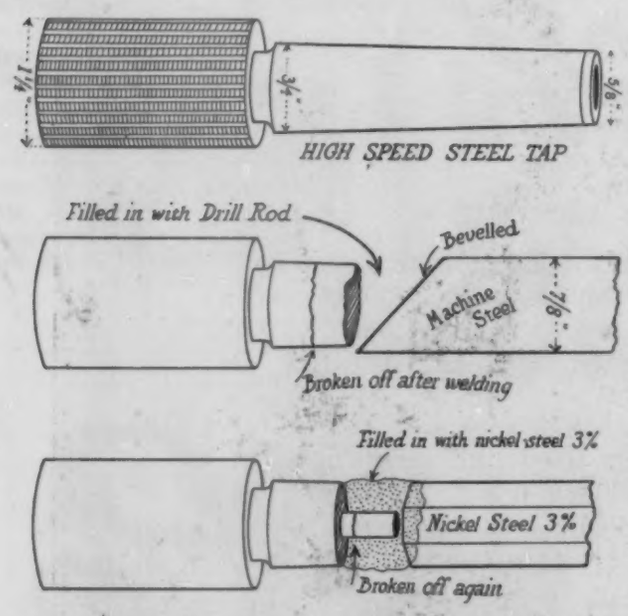
Among the Linde Company's big and little customers who will reap the benefit of this Service, are many who have learned from dear experience, the folly of depending on a private or a single-plant source of supply for widely fluctuating Oxygen requirements.

Copy F of this series will tell how Linde Cylinder service meets freight congestion problems.

The Linde Air Products Company
42nd St. Building, New York City, N. Y.
"Largest Producers of Oxygen in the World"



to be welded to the shank, using a 1/8-inch or 1/4-inch nickel steel welding rod and a cleaning powder used for cast iron. During the operation the tool shank should also be preheated at the edges where it is to be welded, to a cherry red. Then the high speed steel is set close to the shank as shown at the left in Fig. 1, and welded on both sides with the same welding rod, starting from the end. No cleaning powder is



necessary on these welds. Then place the tool on the edgewise as No. 2 Fig. 1, and weld in the same manner as above.

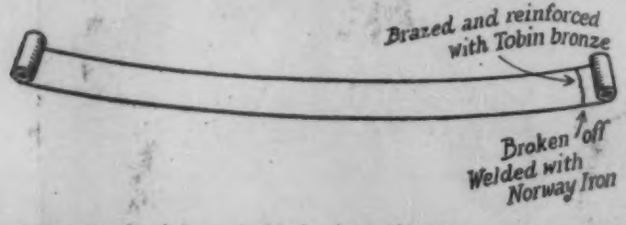
"If the welding operation is properly done the above method will prove as good as if it were a solid forged high speed tool."

We would be glad to hear from our readers on this problem.

Editor.

Editor:

I welded a spring leaf for a motor truck about three months ago with good success. It was broken at the end, close to the lug where bolt fits in. I beveled the edge and then welded with Norway iron. On the other side I brazed it with Tobin bronze, also reinforcing spring. It has been doing heavy work since and is still holding. Since then the lug on the other side has broken off and I welded it in the same manner and it has held up for nearly a month. I did



not expect the job to hold, in fact did not want to take it in, but my customer insisted upon trying, as a new spring could not be secured inside of a week or ten days. I used borax as a flux, thinking it might help by forming a coat around break while welding and also clean up the metal.

Geo. L. Gunther.

Steel castings should be handled in a manner similar to cast iron. They may be preheated and prepared in the same way. Cast steel as a rule has a percentage of carbon between that in mild steel and grey cast iron. As a filler use cast bars of same material. If not available use Vanadium or Norway iron.

OXYGEN BLOWER AND PREHEATER.

Gustave Miller, manager of the Standard Welding and Mfg. Co., Los Angeles, California, has brought out a new patent blower and preheater, as shown in accompanying photo.

This machine will help a great deal in the welding line, also for other purposes where great heat is required, especially for outside jobs.

The machine is designed with two burners, built very light, on two wheels, easily handled by one man and directed wherever wanted.

One tank is filled with Distilled Oil, under air pressure, and another tank is filled with Oxygen. A regulator corrects the air or oxygen mixed with oil at the inlet of the burners. On lighting a match at the outlet of the burners it will work immediately, without preheating the burners.

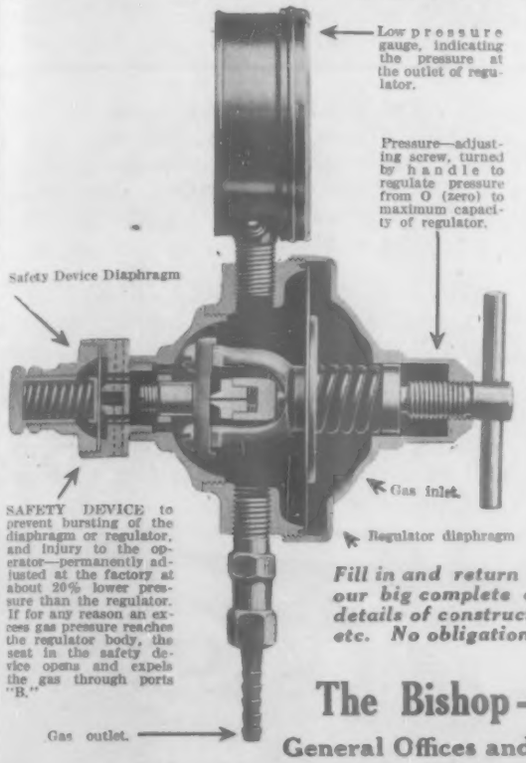
This machine is built for safety in every way and fully guaranteed as to workmanship. The operating expenses are very small—one gallon of oil and five cubic feet of oxygen in one hour.

The machine was also tried out successfully for burning weeds on and since July 17, 1916, at the Standard Welding Works in Los Angeles in the presence of representatives of the Engineering Department of the City of Los Angeles, also of the Engineering Department Pacific Electric, The County Road Superintendent, the City Engineer of Monrovia and Mr. A. B. Paine, Consulting Engineer.

The machine is intended for burning green, growing and troublesome weeds, burning the seeds and burning the plant into the roots. This is to be followed by a tank filled with weed killing solution, which has been applied successfully in a number of places and contains no arsenical or positive poisons. At the same time the machine will act as a fire extinguisher. Price and information may be had from Mr. Miller.

The heaviest weld that has been successfully made in the shop of the Michigan Railway has been on the cracked shanks of old Sharon type and Tomlinson radial type M.C.B. couplers. The approximate first cost of one of these coupler shanks is $12.50, and the cost to weld it is $2. Welds in simpler form are frequently made to obviate delays in the receipt of material, thus making it unnecessary to carry a large stock of spare parts in the storeroom. For instance, GE-239, 2400-volt, brush-holder receptacles that have been burnt in service are readily put in condition for operation. In one of the accompanying illustrations, one of these brush-holder receptacles in need of repairs is illustrated, together with one that has been restored. For this work a scrap brush is fastened to the receptacle during the welding operation to serve as a mold for the inner surface of the brush-holder receptacle.

Our DIAPHRAGM SAFETY DEVICE


Low pressure gauge, indicating the pressure at the outlet of regulator.
Pressure—adjusting screw, turned by handle to regulate pressure from O (zero) to maximum capacity of regulator.
Safety Device Diaphragm
Gas inlet.
Regulator diaphragm
SAFETY DEVICE to prevent bursting of the diaphragm or regulator, and injury to the operator—permanently adjusted at the factory at about 20% lower pressure than the regulator. If for any reason an excess gas pressure reaches the regulator body, the seat in the safety device opens and expels the gas through ports "B."
Gas outlet.

Insures Safety to the Operator —Prevents Accidents

Because of the nature of oxy-acetylene welding and cutting, it is of the utmost importance that the apparatus used be properly designed and made, to insure the safety of the operator. This Special Diaphragm Safety Device makes accidents impossible. You will understand the operation of it by referring to illustration and marginal notes at the left.

We have constantly had in mind the safety of the operator while designing all B-B-B Welding and Cutting Apparatus — regulators, torches and all accessories.

Fill in and return the Coupon for our big complete catalog, showing details of construction, with prices, etc. No obligation to you.

The Bishop-Babcock-Becker Co.

General Offices and Factories, Cleveland, Ohio

Branches in the Larger Cities

The B. B. B. Company, Cleveland, Ohio.

Please mail your complete catalog of Oxy-Acetylene Welding and Cutting Apparatus, with prices, etc.

Name.....

Address.....

W E.—9-'16

VERTICAL WELD ON CAST IRON.

(*Continued from page* 24)

is held with tip pointing toward outer edge of weld, upon melting the metal will have a tendency to run away.

The operator should not become discouraged after the first few unsuccessful attempts, but try to be guided by determining the cause of the failure. Confidence is one of the main requisites of the operator in the welding trade. He must believe he is capable of doing a thing, then try until he finds a way to accomplish the purpose.

As an incentive to others, a bit of twentieth century common sense is herewith copied.

Things are moving so fast nowadays that people who say it can't be done, are constantly being interrupted by some one doing it. "That's us."—Author unknown.

This common sense printed upon a card is posted within sight of all who enter the shop where the writer is employed, which denotes "We are on the job." It's a good motto, why not adopt it?

J. B. Diehl.

SWITCH ENGINES.

A certain man's name was mentioned in a casual conversation the other day.

"He's a switch engine," said the Sales Manager. And that seemed to succinctly summarize him.

His average tenure of a position was about a year. In ten years he had held twelve different positions with as many different concerns. He was truly a "switch engine."

Now a switch engine has important work to perform in the yards of any railroad, but a human "switch engine" is a liability rather than an asset. * * *

This a word of warning again—if you are becoming a "switch engine," call a halt on your wanderings, get a steady job on the main line and stick to it. In the course of time you may then get a run on the Business Unlimited—the crack train of the system.—*The Layman Printer.*

"Fyber-Weld" Industrial Goggle

The Welder's Delight—Made of fibre—an absolute Non-conductor of Heat. Light and durable.

No. 510. Fitted with Our Famous Essentialite Lenses the exact glass for protecting the delicate organism of sight against Ultra-Violet and Infra Red rays.

Price $3.00 per pair.

No. 510. Fitted with Smoke Green Lenses.
Price $2.00 per pair.

Fyber Spectacle

No. 511. Fitted with Smoke Green Lenses. $1.00 per pair.

No. 511. Fitted with "Essentialite" Lenses. $1.50 per pair.

Manufactured exclusively by

THE CHICAGO EYE SHIELD CO.

Safety Dept. No. 33

2300 Warren Ave. Chicago, Illinois

Trade News

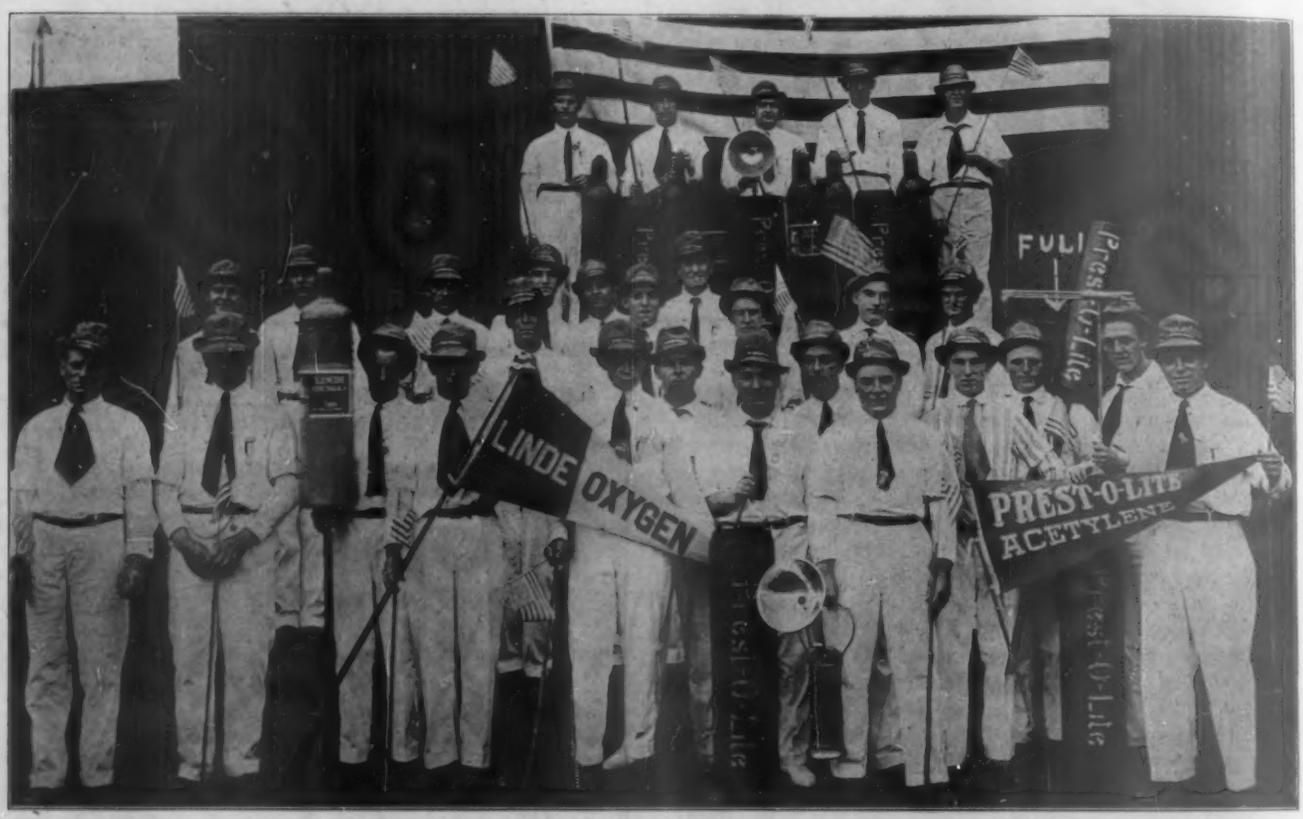
WELDERS ON DRESS PARADE.

The development of the welding art has evolved many striking changes in the commercial world, and not the least has been the creation of an entirely new and special class of skilled artisans—the operators themselves.

The above photograph shows the Oxy-Acetylene Cutting Operators of the Robins Dry Dock Co., Brooklyn, New York, taken just prior to their participation in the parade of 1,600 Robins employees on August 5th, of which Pathe motion pictures were taken. Wooden facsimiles of Linde oxygen and Prest-O-Lite Acetylene cylinders were carried.

The small reflectors seen in the picture are those of the Prest-O-Milburn Flare Light which can be attached either to a large Prest-O-Lite cylinder for stationary use, or to a small cylinder for portable use.

Cutting a big ocean liner in two and enlarging the ship by putting in a whole new section is all in the day's work for the Robins operators. A few years ago, who would have believed that?



The steamer George E. Warren was recently cut in two and lengthened from 260 feet to 310 feet. The Robins Dry Dock Co., Brooklyn, did the job. Illustration shows oxy-acetylene operators.

The twelfth annual convention of the Railway General Foreman's Association was held at the Hotel Sherman, Chicago, August 29th to 31st, the meeting being adjourned one day early because of the threatened railroad strike. Among those who exhibited were the following companies: Goldschmidt Thermit Co., Imperial Brass Mfg. Co., Oxweld Railroad Service Co., Squire Cogswell Co. (representing Hauck Mfg. Co.) and the Mahr Mfg. Co., Manufacturers of preheating torches.

NEW MILBURN CATALOG

The Alexander Milburn Company, Baltimore, Md., have recently issued a handsome catalog, illustrating Milburn oxy-acetylene welding and cutting apparatus. There are thirty-two pages, covering everything from a simple outfit to a complete generating plant.

ELECTRIC WELDING OF PULLEYS.

Another special machine has been developed by the National Electric Welder Company, Warren, Ohio. It is designed for welding pulley fillers to rims ranging from 12 to 60 in. in diameter. Apart from the great range of automatic operation, the machine is characterized by a small number of moving parts, simplicity of operation and the provision of complete and separate welding equipment on each side of the pulley center.

Water cooling is provided for the welding points, which can be withdrawn to give a clearance of 12 in. between them. If desired they can be arranged to operate within a radius of 2½ in. from the center of the arbor. The feeding and the stopping of the work are automatic, the feed device being adjustable from ½ to 3 in. between welds as desired. The stops operate automatically to trip the machine. The desired distances between centers and the face of the work are secured by an adjustable mandrel.

Motor drive and an automatic switch are provided for each of the welding equipments which have a capacity of 60 welds per minute each. The floor space occupied by the machine measures 50x66 in. and the weight of the machine is approximately 3,500 lb.

NEW SEARCHLIGHT CATALOG

The Searchlight Company, Chicago, have issued catalog No. 12, with a new price list on welding supplies, dated August 1st. The catalog describes in detail all kinds of welding and cutting equipment, including regulators, gauges, supplies, etc.

SPOT WELDING PATENT DECISION.

A decision was given July 11, 1916, and an interlocutory decree was issued July 17, by the United States District Court, District of Massachusetts, in the case of the Thomson Electric Welding Company, et al., vs. Barney & Berry, Inc., holding that the defendants had infringed the Harmatta patents on the process of spot welding. The Universal Electric Welding Company, licensee under the Harmatta patents, was associated with the Thomson Electric Welding Company as complainant. The decision thus given was in pursuance of an opinion given by the United States Circuit Court of Appeals for the First Circuit, on Oct. 5, 1915, in which a decision in the district court was reversed and the case remanded for further proceedings. The plaintiffs did not seek recovery of profits for any use of the process before the patent issued on Dec. 3, 1912, nor for any articles produced before that date. The decree of July 17 provides for a referee to determine profits derived by the defendant from infringing machinery and to assess damages. An injunction was also issued restraining the defendant from practicing the process of electric welding. One of the questions raised in the litigation was whether the operation of welding skates, as practiced by the defendants, came under the designation "spot welding." The early Thomson patents on electric welding, including the process of butt welding, were not involved in the action.

WANTED—Live, hustling, adaptable young man of mechanical ability who can handle work in shop and improve welding conditions. A good chance for the right man. Eug. Bournonville Welding Co., 241 W. 64th St., New York, N. Y.

FOR SALE—One of the best equipped welding shops in southern California, a city of 90 thousand, doing a good business and well established. Will sell all or one-half interest. Owner has another business calling him from the city. C. E. Henderson, San Diego, Calif.

Situation Wanted:

A-1 welder wants position by Oct. 1st or 15th. Six years' experience. All metals—big jobs are easy for me. Would consider taking charge of shop. Best reference.

I. H. Hobday,
993 Sweitzer Ave.,
Akron, Ohio.

25 CENTS. COPY
G W & E CO
INSTRUCTIONS
FOR WELDING
AND CUTTING
NOTE: THESE INSTRUCTIONS ARE NOT ONLY FOR THE OPERATOR, BUT IN THE FIRST PLACE FOR THE MAN HIGHER UP TO KNOW THE ESSENTIALS AND THEN SEE THE ENORMOUS POSSIBILITIES WITH AN UP-TO-DATE EQUIPMENT.

Can You Sell Welding Materials

If you are familiar with the welding business and can sell goods to the welding trade, and can carry a stock of materials worth at least two hundred dollars, we have a good proposition for you.

Write us about your territory. We need more distributors.

WELDING MATERIALS
720—115 South Dearborn Street
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WELDING PHOTOGRAPHS
We make a SPECIALTY of photographing welding jobs
Chicago Architectural Photographing Co.
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Oxy Acetylene **U.S.** Welding Apparatus
Cutting and Decarbonizing Apparatus
Parts and Supplies
UNITED STATES WELDING CO., Minneapolis, Minn.

THE SUPERIOR GREAT PRICE WRECKERS
of Oxy-Acetylene Welding and Cutting Equipment and Supplies
For the month of September only we offer

1 Superior Welding Torch, 7 copper tips	$10.00
1 Superior Cutting Torch with 3 tips and roller guides	17.00
1 Double Oxygen Regulator, 2 gauges	15.00
1 Double Acetylene Regulator, 2 gauges	11.00
1 Acetylene Regulator, 1 gauge	4.75
1 High Pressure Oxygen Gauge, 3,000 lb.	4.50
Aluminum Welding Rods, per lb.	.68
Tobin Bronze ¼-in. Rods, per lb.	.52
Oxy-Acetylene High Pressure 5-ply Hose, 100-ft. lengths	.06½
Armored Copper Covered Hose, 100-ft. lengths	.21

Prices on other supplies upon application

Superior Oxy-Acetylene Machine Company
Hamilton Ohio

THE APPLICATION OF THE ARC WELDING PROCESS IN PRESSED STEEL MANUFACTURING PLANTS.

By Robert E. Kinkead.*

The reasons for applying any kind of welding process are, in the first place, a large percentage of the pressed steel parts as they come from the dies are imperfect. Second, mistakes are made in drilling holes which must be corrected, and third, the pressed steel products are usually assembled and fastened together and welding can be used in place of riveting.

A part of the imperfect pieces which are made are defective due to insufficient metal in certain parts of the piece which is caused by the improper placing of the piece in the dies prior to pressing. This leaves what is known as a "short side" and the piece must be rejected and scraped if no way is provided for building up the "short side." The building up process is done with the metal electrode and the piece is afterward ground so that it is impossible for the ordinary inspector to tell the difference between a perfect piece and one which has been imperfect and later been corrected. Another source of imperfection is from pieces which are difficult to make by the use of a press and dies. The quality of the metal used has a great deal to do with this. Either due to low quality of material or to the difficult shape of the piece, cracks often occur while the part is being pressed out. These cracks may be very insignificant in a practical sense, but are sufficient to cause the rejection of the pressed piece by the inspector, or the cracks may be sufficiently large to render the piece unfit for use. All plants making any quantity of pressed steel products get raw material which varies in quality, since it is impossible with the present methods of manufacturing steel to make it to a given analysis, in fact, the analysis may vary slightly in different parts of the same sheet. This is a source of a great deal of trouble to the pressed steel plant.

The arc process permits the correction of such defective pieces at a comparatively low expense and the welded piece is satisfactory for the service to which it is to be put. The welding together of pressed steel parts is a comparatively recent development. Practically everything from pressed steel automobile wheels to steel barrels have been welded by the arc process. There is a limitation to the development here, however, due to the fact that the welded joint will not stand a great deal of bending or severe blows. Each application is a problem in itself and cannot be treated in general terms. The present tendency, however, toward the cheapening of automobiles will undoubtedly produce a much greater activity in the direction of substituting welding for riveting on the chassis. Some work is being done at the present time on rear axles, on pressed steel running boards and the welding in of malleable iron metals to support the spring. The field here is a broad one but it seems to be up to the automobile builders to utilize the process, rather than for the welding apparatus manufacturer to stake his success on the application. The pressure which is being brought to bear upon the manufacturers of automobiles to reduce their cost will certainly produce results in this direction. The application of the process in the correction of mistakes and flaws in the product of a pressed steel plant is good enough to warrant the installation of the apparatus and it is for this purpose that the first plants are usually installed. Later on as the manufacturer gains more confidence in the process and realizes its cost reducing possibilities, the application in the welding together of pressed steel products follows naturally.

The size unit depends entirely upon the class of work the company does. As a general proposition the 150 ampere unit represents the maximum amount of capacity that will be required. Where the work is all on thin sections a 100 ampere unit is of ample capacity. So far as the operation of the equipment is concerned the nature of the work does not require a great deal of skill on the part of the operator and 35 cents per hour probably represents the maximum that is paid any operator for work of this nature. The average is in the neighborhood of 25 cents per hour.

*Engineering Department, The Lincoln Electric Co.

WELDING ON RAILROADS

In the Milwaukee Electric Railway & Light Company's shops a novel application of the oxy-acetylene flame has been developed in the burning of lead to make lining material for storage battery boxes. In connection with this work, as well as the regular welding operations that are carried on with the apparatus it has been found that the cost of the work depends largely upon the element of time. H. A. Mullett, superintendent of rolling stock, states that the operating cost per hour ranges from 40 cents, when a No. 2 tip is used, up to $1.17 when a No. 7 tip is used.

On the Chicago Elevated Railways, H. A. Johnson, master mechanic, states that the uses to which it can be put to advantage have been continually extending, and in cases of emergency the value of the apparatus is considered to be not measurable in dollars and cents. Some of the work which is being done is as follows: Building up worn pinion fits, keyways, stripped threads on armature shafts, and worn motor housings, welding broken motor shells, building up worn brush holders, worn nose suspensions and many other jobs of a similar nature. The company has tried also the filling up of flat spots on steel wheels when the flat spots did not come close to the flange. Out of several operations of this kind one was found where the metal sloughed off, but as a whole the experience is considered to be satisfactory. It is considered that in many cases the actual cost of doing a welding job is not the most vital feature. In many cases time is the determining factor, especially in cases of broken machinery, where the replacement of a part would necessitate a long delay in the receipt of new castings. In Chicago the question of breaking in operators has not been a serious matter, as a shop employe may be sent to the establishment of one of the manufacturers of oxy-acetylene apparatus where repair work is handled and he can work for three or four days beside an experienced operator, picking up in this way more knowledge than he could in the railway company's shops in a considerably longer time. For the welding operators, a knowledge of the welding and working of methods is considered to be a material help in the proper handling of the welding apparatus, and for this reason the company is using blacksmiths to do the gas welding.

WELDING HIGH SPEED STEEL

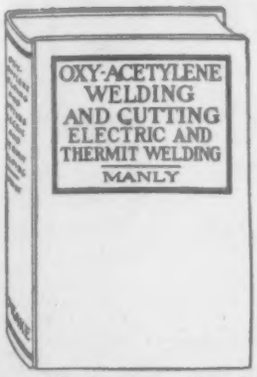
It has been found that electrically welded tools will actually produce 10 per cent more work than solid tools, before regrinding is required. This is believed to be due to the reinforcing metal which is built out and around the tip, serving both to give large radiating surface and to afford a larger heat conducting path back to the butt of the tool, thus keeping down temperature at the cutting edge.

The composition of the high speed steel is comparatively unimportant, as nearly all commercial brands are being welded successfully. The records on this type of welding show that so long as high speed tool steel costs over $1.25 per lb. it will be economy to weld tips on cutting tools.

Chrome steel, if in the class of mild or low carbon steel, can be welded readily. Weld as mild steel, using chrome steel filler. Many chrome steels, however, are in the high carbon or hard steel class and should be treated accordingly.

Oxy-Acetylene Welding and Cutting
Electric and Thermit Welding

By HAROLD P. MANLY



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Hints To WELDERS

Can you write intelligently about the welding work you do, or which is done under your supervision? That is to say, when you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work, how you preheated and how the job was done? Have you learned in the hard school of experience some little stunt which every welder ought to know? If you can answer yes to the above questions you are the man I am looking for. I'll pay you a fair price for that bit of experience and I'll print it in The Welding Engineer "Hints to Welders" where more than 4,000 of your fellows will see it. Write it down any old way—I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today—the men on the firing line are waiting.

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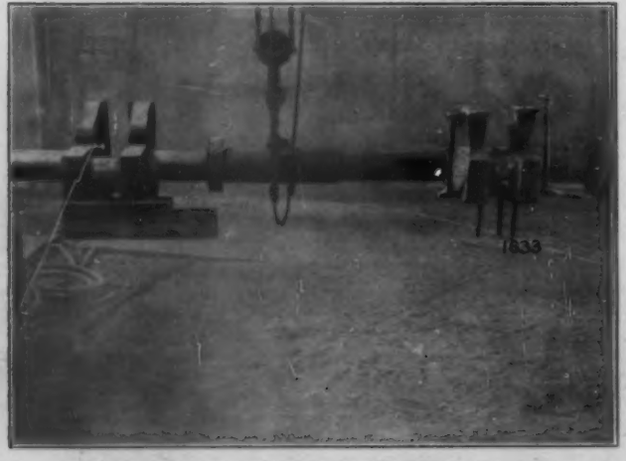

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